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EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

JULY THE FOURTH is a great day in the mining communities of the West. It is celebrated in a variety of ways. This year more interest than ever has been shown in preparation for drilling contests, first-aid exhibitions, and mine-rescue demonstrations. These, apart from the element of spectacular sport, in itself agreeable, are educative and informing.

HUERTA says that "it is easier to crush cement than to crush a Mexican revolution." It certainly is better to make a durable building material than to add one more to the several 'revolutions' already in progress. Mexico needs a constructive building material that will give it a government reinforced to resist the ambitions of unscrupulous adventurers.

IN the making of an 18-lb. shrapnel shell the consumption of metal is as follows: copper, 4.04; zinc, 1.87; lead, 6.93; antimony, 0.99 pounds. The larger shells require more brass, that is, more copper and zinc. Estimating the European orders already placed in this country at 25,000,000 shells, this involves the consumption of 101,000,000 pounds of copper, 46,750,000 of zinc, 173,250,000 of lead, and 24,750,000 pounds of antimony.

SPEAKING of zinc, this is imported into South Africa through Delagoa Bay. Most of it used to come from Germany; now most of it is imported from the United States. During the five months August to December 1913, all of it, namely 1758 tons, came from Germany. In the same period of 1914 only 402 tons came from there, while 2058 tons arrived from the United States. Now presumably all of the supply, 2500 tons, comes from here.

ACCORDING to the Bureau of Foreign and Domestic Commerce, the exports of spelter in pigs, bars, plates, and sheets was 120,149 pounds in April last year, as against 17,683,173 pounds in the same month this year. Another comparison is based on the ten months covering the period of war, thus:

Exports of zinc or spelter.	Pounds.
In 10 months ending April 1915	222,478,162
In 10 months ending April 1914	3,243,418
In 10 months ending April 1913	4,997,680

These statistics are eloquent.

STANFORD is to be congratulated on its new professor of geology, Mr. Bailey Willis, who succeeds Mr. John C. Branner, now president of the University. Mr. Willis is known to mining engineers for his work on the Geological Survey and his scientific investigations in China. Recently he has been serving as consulting geologist to the Argentine government. Thus, like Dr. Branner, he understands South American conditions and is well fitted to further the *rapprochement* between the two Americas by preparing students for geological exploration in the southern continent.

COPPER SHARES have not risen in proportion to the price of the metal. On a 20½-cent quotation their earnings ought to increase by 50 to 60% as compared with copper at 16 cents, which was the price three months ago. This means, in the first place, that the benefit of the higher price does not come into operation at once, as copper is sold for forward delivery, and it also suggests that the public is waiting to see if the enhanced quotations persist. We believe they will.

THE CHUQUICAMATA mine, owned by the Chile Copper Company, is destined to put even the Rio Tinto and Calumet & Hecla in the background. Mr. Pope Yeatman estimates the ore assured at 303,300,000 tons averaging 2.23%, and he regards it as certain that the tonnage will reach 400,000,000 "without by any means limiting still further possibilities." The mill, of 10,000 tons daily capacity, was started on May 18 and is expecting to be working to full capacity by the end of the current year. It is intended to enlarge the plant to a capacity of 30,000 tons per day, not per week or per month. The estimate of cost, treating 10,000 tons daily, is $2.10 per ton on a 2% ore. Copper is to be delivered in Europe for 6 cents per pound. Thus, by the beginning of 1916, this mine will be producing at the rate of 75 to 100 million pounds of refined copper per annum.

MISFORTUNES of a serious kind have befallen the Treadwell group of mines, on Douglas island, Alaska. On June 19, the main shaft of the hoisting-engine at the Central shaft broke. This, of course, is a heavy piece of hammered steel, weighing fully 30 tons, so that it cannot be replaced in less than two months, although it could be repaired by the use of thermit at Seattle. Through the Central shaft is hoisted the ore that feeds the Treadwell, Mexican, and 700-Ft. mills, but not the Ready Bullion. A far worse mishap occurred on June 15 when the ground on the south orebody of the Treadwell caved from surface to the 1400-ft. level and at the same time the north orebody caved to the 900-ft. level. This collapse of ground is due probably to the drawing of the caved ore from the stopes below the 750-ft. level. Additional caving ensued, affecting the main pillar between the No. 2 and No. 9 open-cuts. Apart from the interruption to production, this caving

must entail serious loss by rendering unavailable a large tonnage of ore. The two misfortunes have caused a nearly complete cessation of milling, for the present, but the use of the Mexican shaft should enable the Mexican and 700-Ft. mills to resume work, while the Treadwell, we presume, will have to reorganize the No. 2 shaft, a task requiring two or three weeks. Mr. J. H. Mackenzie, in the absence of Mr. F. W. Bradley, now at Honolulu recovering from a recent illness, has gone to Treadwell to consult with the manager, Mr. Philip R. Bradley.

LAKE COPPER has for many years commanded a premium over electrolytic. The Calumet & Hecla and Quincy copper is free from arsenic and other deleterious impurities that render copper less ductile and decrease its electric conductivity. When the electrolytic copper-refining process was first developed the copper made by it was more impure than the Lake product. The process has been so perfected that this condition no longer obtains; nevertheless, many consumers still specify Lake copper and prefer to pay the premium for metal they know is pure rather than take a chance with metal that has been purified. Meanwhile the arsenic content of the Lake ores is increasing, and a short while ago the Calumet & Hecla built an electrolytic refinery to handle part of its output. Some of the mines, such as the Mohawk, Wolverine, Baltic, Champion, and Trimountain, produce copper that contains arsenic in sufficient amount to make it desirable for fabricating seamless tubes, sheets for boilers, locomotive fire-boxes, and other uses for which hard copper is desirable.

ALASKA is indebted to the Secretary of the Interior, Mr. Franklin K. Lane, for publishing a clear statement in regard to the need for a simpler administration of the great northern territory. His statement appears in *The New Republic*, a periodical of growing influence. The President has spoken of Alaska's resources and the development of them in sympathetic terms. They "must be used, but not destroyed or wasted: used, but not monopolized under any narrow idea of individual rights as against the abiding interest of communities." That means, among other things, that the mineral resources of a vast region are neither to be monopolized by adventurous individuals and venturesome corporations nor bound in impotence and unproductiveness by departmental red tape and administrative delays. Alaska has suffered quite as much from one set of evils as the other. The "abiding interest" of neither the territory itself nor the United States is served by irritating restrictions upon intelligent initiative and honest development. Mr. Lane recognizes this, and it is of good augury for Alaska, since he is in a position to give effect to his ideas. He advocates the creation of a single Development Board, appointed by the President and confirmed by the Senate. This Board, while responsible to the Secretary of the Interior, should do the work now scattered and duplicated among the General Land Office, Forest Service, Road Commission, Bureau of Mines, and Bureau of Education, besides the Secretary of the Interior. If some such centralization and simplification of authority could be effected, so as to end the wearisome delays in obtaining title to homestead and mining locations, and in starting any sort of new work in a region awaiting sane exploitation, the people of the North will be ready to exclaim: "For this relief, much thanks."

A Rare Chance

From time to time we hear that financial corporations or exploration companies find great difficulty in their search for new business, that is, promising mines at reasonable prices. We realize that a good mine at a fair price is a rare bird. It may be suggested that the search for this desideratum has been so lively and so thorough that the chances of a kill are poorer than they used to be. Perhaps. But it is equally true that the criteria for the purchase of a mine are more exacting than heretofore. People, especially the clever people that control these mine-searching expeditions, know more than formerly; they will not buy a "pig in a poke"; they refuse to put their money down until a careful investigation has been made by competent engineers. Moreover, even the public has gained wisdom in these matters—not a great deal, it may be, but enough to know a brick from a bar of gold. Therefore, it is no longer easy to "pass the buck," that is, to unload a disappointing mine upon the unwary. Undoubtedly the whole business is no longer on the amateur footing that it used to be. If, in consequence, money is not made in chunks, at least it is not lost with the inconsequence of a drunken sailor. However, we shall not try to discuss so broad a subject on this occasion; our purpose is to touch on one particular aspect of it. With knowledge has come caution, sometimes of a paralyzing kind. Risk is inherent in a speculative business like mining. It is necessary to ascertain the facts as carefully as possible and then go ahead, not collect facts and then stare at them helplessly. Yet this has been done on more than one occasion when the chances of a lifetime have been offered. We quote one case, on first-hand information. A Columbia student, taking a holiday in Canada, happens to go to Haileybury at the time of the Cobalt boom. The little hotel is crowded, but he is fortunate enough to get a bed. After dinner, sitting in the lobby, he enters into conversation with an elderly gentleman, of kindly disposition, but lacking a bed. He offers his own, saying that he is used to roughing it and can sleep on the floor. The offer is accepted gratefully. Next day he is taken by the elderly gentleman, whom we will call Colonel Tompkins, on a tour of the new district. Later, in parting, he is invited to ask for a job when he has graduated from the School of Mines. In the course of events, he does so and is sent as a scout to Nevada. He goes to Goldfield. There he meets another Columbia graduate (No. 2) who has just finished a sampling and mapping of the Mohawk mine, then a wonderful prospect. No. 2 tells him it is a good thing and that an option is obtainable. They examine the evidence. No. 1 gets an option on 351,000 shares, that is, the control, at $2 per

share. Thereupon he telegraphs to the Colonel, urging him, as representative of a well-known corporation, to take action promptly. When the telegram arrives, the quidnuncs at headquarters decide that it is absurd to think of paying $702,000 for a mere prospect. They do not even take the trouble to make an examination. This was in June 1906. A few months later the shares of that mine sold at $20 per share, because one of the big bonanzas of the world had been uncovered. The Mohawk needs no encomium now; it has been worked out for a yield of millions and is the nucleus of a big consolidation, still productive. The moral is plain; don't send a scout unless you can trust his report. Moreover, if you are in the business, never lose a chance merely to save the expense of an investigation. As James D. Hague said long ago: "Mines are like the saints, for many are called and few are chosen." The chosen wear a halo.

Flotation

This is a metallurgical subject of such commanding interest that we are glad to give our readers a critical description of one of its latest phases, in the form of an article on the experimental work preceding the construction of the Inspiration mill. Our contributor gives a particularly lucid account of the work done at this important copper mine in Arizona. In his case, we believe, the knowledge of the subject is supplemented by the ability to transfer that knowledge to others. We regret that the compliment must be impersonal, since the author of the article writes under the veil of anonymity. His foot-note makes humorous reference to the shyness of a preceding writer on the same subject. Indeed the metallurgic art of flotation at the present time is characterized by a great deal of mystery, due, of course, to patent litigation. The hearing of the case between Minerals Separation and the Miami copper company has been proceeding for eight weeks before Judge Bradford of the U. S. District Court at Wilmington, Delaware. Incidentally, we may mention that a special cinema apparatus was designed by the plaintiff to illustrate the operations involved, and, in order to do this effectively, it was necessary to take 120 photographs per second (as against the 10 or 12 taken in the ordinary moving picture) with an exposure of one ten-thousandth of a second. Whatever the decision, an appeal is certain. That appeal, we understand, will come before the very Court that gave such a sweeping decision in the Moore-Butters filter case. Strategy appears as useful in legal battles as in those of a more lethal arena. If Minerals Separation loses, we presume that the secrecy beclouding the rapid advance of this branch of metallurgy will be thickened, while if the major patents are sustained it may be that the proprietors will give information with some freedom. Assuredly it is altogether to the interest of the profession and the industry of mining that information of the kind given in the Inspiration article should be published. It injures nobody; it helps many. We hope that other members of the profession will avail themselves of the opportunity to do likewise.

Metal Prices

The trail of the Great War crosses all things human. It has left its traces on the metal trade. In the early days of the conflict, last year, quotations for the base metals suffered collapse. Even after a temporary recovery the effects lingered. In common with others we were led to appreciate the artificial character of a market that was in the hands of a group of metal-brokers, competing, it may be, among themselves as to the division of the profit, but united in fixing quotations that suited their books. This feature was helpful to the industry during the crisis last August, when the metal-selling agencies came to the rescue of the market by uniting in a refusal to sell copper at panicky prices. That much must be allowed in all fairness. But there is another aspect to which we must direct attention. In London, Melbourne, and New York, during the crisis, the same European names appeared behind the local brokerage houses and metal merchants. The combination was suggestive, if not suspicious. It boded ill for the mining industry that the sale of its metallic products should gravitate so nearly to one point, to what was practically one international or non-national group of speculators. We have made an effort to protect our own readers, at least, by changing the source of our metal quotations. It will interest the owners of mines to know that until recently the *Engineering and Mining Journal* and the Mining and Scientific Press both obtained their metal quotations from the same source, a source believed to be absolutely reliable, and *The Mining Magazine* obtained its quotations from the London correspondents of the same house, also believed to be absolutely reliable. No reason exists even now for suspecting that there was anything wrong, but the disclosures made at Adelaide in the Snow trial indicated to us that the New York firm and its affiliated London house were both members of a group of brokers that exercised an unhealthy dominance over the metal trade, a dominance that might easily be misused. Therefore we decided to safeguard our readers by obtaining quotations from a source wholly independent; in other words, to obtain not the metal-brokers' quotations but the consumers' prices. This we have done now for several weeks. The page entitled 'Eastern Metal Markets' and the telegraphic quotations given each week may be accepted as reliable to the utmost degree possible. We commend the study of them to those having in charge the sale of the metals produced by mines on this continent. We give as accurate an approximation as is possible of the actual prices that consumers are called upon to pay for the metal they purchase for use in their business. Such prices are called "approximate" because frequently there are deals put through at varying figures in the course of a single day, sometimes in the course of a single hour. Copper, for example is often quoted in certain trade publications, and therefrom in the daily and weekly press, at prices for which the metal cannot be bought, yet with them goes no explanation that the quotation is not for the consumer. The price is not real, for the metal cannot be had at the figure mentioned. Is it not absurd that when one sees a

price quoted and asks a seller: "Will you sell copper in any quantity at that figure?" he should answer "No." If the question is then asked "Will you tell me where I can get copper at that figure?" and again the answer is "No." Finally, "Is it possible for anyone to get copper at the figure quoted?" And the answer is still the same. Sometimes the selling agencies connected with producers will endeavor to encourage speculation by bulling prices. For instance, on a recent day the Wall Street papers that get their information from the big agencies said that producers were holding copper at 19 cents full terms for electrolytic, with some offerings at 18.875c., while a buyer for export stated that he could get copper in almost any quantity between 18.50 and 18.62½ full terms, or 30 days, delivered. In an intricate business such as that of metal-selling there are many ways that are dark and tricks that are not in vain. The operators of a small mine, and even those controlling the bigger ones, are rarely in a position to protect themselves. We offer them one measure of protection by giving them the prices that the consumers are paying for copper, lead, and zinc. On the earnestness of our effort to secure absolute trustworthiness of the figures we pledge our honor.

Bismuth

Bismuth is one of the metals that command a high price merely because they do not occur in abundance; the price of it is based on the demand and not on the cost of production, which is probably only one-eighth of the selling-price. Not uncommonly bismuth is found as native metal, as in the famous mining district of Schneeberg, in Saxony, and in other places in Bohemia and Saxony. It is also found in Chile, Bolivia, Sweden, Norway, and Australia, usually in association with ores of cobalt, nickel, silver, lead, zinc, and gold. Another important mineral frequently associated with the native metal is bismutite, the hydrous carbonate, and with it is often found bismuthinite, the sulphide. Bismite, the trioxide, is also the source of some bismuth; the three closely similar names being somewhat confusing. Tetradymite, the telluride, which looks like graphite, is also not uncommon. No bismuth is mined in this country, the entire domestic production is recovered as a by-product in the electrolytic refining of lead from the anode slime. The plant of the United States Smelting, Refining & Mining Co., at Grasselli, Indiana, and that of the American Smelting & Refining Co., at Omaha, yield 175,000 to 200,000 pounds of the metal yearly. Bismuth also occurs in copper ores, but most of it escapes through the stack in smelting. Blister copper sometimes contains as much as 25 lb. bismuth per ton, but, so far as we know, none is recovered from this source. About an equal amount is imported from Europe, chiefly from Germany, where the European and South American ores are treated, and from England, where ore from South America and Australia is reduced. The ore of the Suan mine, Korea, contains 1.7 lb. bismuth per ton. In Saxony the ores are first roasted, to free them from sulphur and arsenic, and are then smelted in crucibles with iron and charcoal, the bismuth thus reduced collecting on the bottom of the crucible. The metal may also be recovered in the wet way by treatment with hydrochloric acid, taking the bismuth into solution, from which it can be precipitated by dilution as the oxychloride. This must be redissolved and precipitated several times in order to free it from lead; it is then reduced to the metal by fusion with lime and charcoal. Gold and silver can be separated from the bismuth by the use of zinc, by the process used for de-silverizing lead. A great variety of methods have been employed in the metallurgy of bismuth; they are described in detail in Schnabel's 'Handbook of Metallurgy.'

Bismuth has a melting-point of 260° C., but it forms with other metal alloys of much lower melting-point. Thus Lipowitz's metal, consisting of 50% bismuth, 26.9% lead, 12.78% tin, and 10.4% cadmium, melts considerably below the boiling-point of water. In cooling from the molten state this alloy contracts after solidifying until a temperature of 100°F. is reached and then expands until 77°F. is reached, when it again contracts so that at 32°F. it has the same volume that it had at 115°F. This property of expanding on cooling is characteristic of bismuth alloys and makes them desirable for a number of purposes. Thus bismuth is added to the alloy from which stereotype plates are cast in order that a clear impression of the type may be taken. Soap-makers also make their molds from a bismuth alloy. Alloys of bismuth have been used as fusible safety-plugs for boilers, but the continued action of heat changes their melting-points, so that they cannot be relied upon. The ready fusibility of its alloys makes them useful as fuses in electrical construction, and considerable quantities of the metal are probably consumed in this way each year. It is also a component of the alloy used for silvering mirrors, and as no secondary metal is ever recovered in either of these two uses, this is a true consumption.

No large deposits of bismuth ores have been found in this country, but several small high-grade deposits are known. The Highland Mary mine, at Leadville, has produced some 15% bismuth ore; the Comstock mine, in the La Plata mountains, Colorado, has produced ore containing 18% bismuth; and the Indiana mine, near Ouray, also in Colorado, has produced small lots of ore containing 25% bismuth. It is interesting to note that to none of these mines was anything paid by the smelters for the bismuth content of the ore, but in fairness it should be added that probably none of the bismuth was recovered in smelting, because the use of electrolytic refining, in which the bismuth is saved, has only recently been adopted by the two plants mentioned. Presumably a fair price would now be paid for the bismuth content of ores, and there seems no reason why the domestic output should not increase sufficiently to take care of domestic consumption at least. It is generally believed in this country that the price of bismuth is strictly controlled by a European syndicate that boycotts any producer found guilty of selling below the established price. If this is the case, it becomes all the more desirable that domestic consumption should be supplied by our own producers.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more vaulable than casual compliment.

The Spelter Situation

The Editor:

Sir—When the terne mixture and copper are sold at prices less than that of spot spelter, it can truly be said that the metal market is decidedly out of joint and that the abnormal condition is not one having any degree of permanence. This mushroom growth is an unhealthy one and those who have become temporarily unbalanced by the recent pyrotechnics in the zinc trade and have abandoned former standards in the rating of metals may well consider their steps before treading upon what appears to be solid ground, but in reality is a quagmire. I do not mean by this that real zinc property today is an unsafe investment. However, the prospective investor should not in any way correlate the present spelter prices with the value of blende-producing properties, as some would ask us to do.

The European demand for munitions has created market conditions previously unknown in the spelter trade. To meet these exigencies, the smelter capacity of this country has been greatly taxed. Concentrate, or the immediate product of the mines, however, is to be had in abundance and until increased smelting facilities make possible the treatment of greatly increased tonnage there will not be any such market for the mine-product as many producers believe there rightly should be. The proposed investigation of a 'zinc trust,' which does not and never has existed, by the Attorney-General of Missouri is a misguided movement on the part of the zinc miners to ascertain the reason for the high price of spelter and the relative low price of concentrate. The formation of an association of the zinc producers of Utah and Nevada, as discussed in your issue of June 5, is a well-purposed movement to better the status of the producer, but it seems almost equally inexpedient. While I am not cognizant of the plans of this organization, although wishing them well, I see but little hope of improving their present position without great and unwarranted expenditures in smelter construction. It would be no less than foolhardy to erect smelters in face of the present uncertain assurance that their period of profitable operation would not be limited by the present abnormal market demands. To lease and rejuvenate the old abandoned works of the Middle West might be a possible solution, but even such an undertaking would be fraught with difficulties. The plethora of ore and lack of retort-capacity presents a knotty problem, the solution of which must necessarily be a difficult one under existing conditions.

It has been estimated that the annual consumption of zinc, as alloyed in brass for cartridges alone, by either side in the present European struggle is something over 50,000 tons. The local European smelters are in no way able to meet their demand. It is known that with the beginning of the present conflict, in August of last year, there were large stores of spelter in Europe, but these have been depleted and the output of the English zinc smelters, that at Budel in Holland, the Vieille Montagne plant at Viviez, and the Malfidano plant at Moyelle-Godault are unable to meet the present requirements of the Allies. The Germans are also making plans to regulate economically the supply of spelter to the needs of the armies and have organized the Zinkhüttenvereinigung for this purpose. The price of spelter in Germany has advanced materially, although zinc is supposed to be finding its way thither from the plants of Norway and Sweden, and the smelter at Angleur in Belgium is reported to be producing.

In normal times the consumption of primary spelter in the United States is about 340,000 tons, while the annual secondary consumption is about 50,000 tons. The estimated total spelter consumption of this country in 1914 was about 375,000 tons, and as such there was but a small margin to meet an increased export trade. While the American smelters have been forcing their output and some companies like the American Zinc & Chemical Co., the Hegeler Zinc Co., the Tulsa Spelter Co., the Granby Mining & Smelting Co., the Illinois Zinc Co., and the Matthiesson & Hegeler Co. will add materially to last year's production by reason of the increased retort-capacity, even this has not been sufficient to meet the demand for all purposes. The present smelter-capacity of the United States is possibly 600,000 tons of spelter annually. Of this output in normal times about 200,000 tons is consumed by the domestic galvanizing industry, and herein may be said to be the controlling factor in the present market. Substitutes for galvanized products have been finding a place in the American market for a number of years. Galvanized structural materials, pipe, wire, plates, and the like, are not as essential as formerly deemed by engineers and builders, and protective paints and coatings have proved in most instances to be satisfactory substitutes. With the advance in the price of spelter and galvanized products the protective paints and coatings have found an increased application. This has resulted in many of the former manufacturers of galvanized products abandoning the use of spelter. With the buyers for these companies out

of the market a great part of the 200,000 tons formerly required for galvanizing will be available for the European munition-contractors, with whom the price of spelter is of but secondary importance.

I do not believe that the present price of spelter is completely indicative of the supply and demand; not that the market is being manipulated, but that a complete readjustment of the trade in spelter is taking place, and until the new status of the industry is established to meet the requirements of the War, the balance will continue to fluctuate. For the present, the swing between supply and demand and the corresponding variations in price may be wide and a complete collapse of the market before it reaches its final balance is not without the range of possibility. Even after comparative stability is established, it cannot be considered of more than temporary importance, for with the cessation of the European demand, another readjustment must necessarily follow, and the position of spelter will again gravitate to conform with the ordinary channels of trade.

Chicago, June 24. E. H. Leslie.

Undercurrents

The Editor:

Sir—I wish to offer a somewhat belated criticism of a statement which I noted in re-reading the discussion of the subject of undercurrents in your columns. In your editorial comment on Mr. Ulrich's interesting letter in the issue of June 5, you make the statement that "the alluvial miner has been living in a fool's paradise, deluding himself into an idea that he was making a high extraction because nobody could prove that he was not saving all the precious metal."

As a member of the class designated in your somewhat inclusive term, I wish to state that the average alluvial miner is very far from living in such a beatific state of ignorance. He knows perfectly well that if he is making a 75% extraction he is doing well. The fact that he persists in being satisfied with this is in itself evidence that there is some reason for it.

The great bulk of gold won from hydraulic mining comes from small mines, for the most part, mines in which probably the total amount of capital invested is less than $100,000. The average gold-content is not very high—running from 10 to 20 cents per cubic yard—and in many cases the water season is not more than four months long. In this short time the water must be used to its utmost capacity to pay the fixed charges and interest, the expense of fitting up, and a small profit on the investment. The only way in which this can be done is to get the utmost capacity out of the sluices; and it is for this reason that the small operator looks askance at any complication of gold-saving devices that threatens to cut-down capacity.

When a man is handling a material whose total yield—if complete extraction were made—would only be about 12 cents per ton, his viewpoint is considerably different from that of the man who gains, by a complete extraction, as in the case of quartz mining, 40 to 50 times as much, and more. His only salvation is to get his 'overhead' distributed over as much yardage as possible. If he finds that he can increase his extraction 20%, but in order to do it he has to cut-down his capacity 25%, he is not inclined to make any changes. The conditions that prevail in the average hydraulic mine are practically prohibitive of maintaining a constant feed in the sluices, for instance; and alternate flooding and choking of any complicated gold-saving device will result in having to turn off the water until it can be cleaned out. This is ruinous, of course, to capacity. Conditions are not at all analogous to those of any other form of mining, even dredging.

This is perhaps one of the main reasons why hydraulic mining is today in the same primitive condition that it was forty years ago. It is better economy to let some gold go over the dump than to lose time and water. The bump of the bounding boulder through the sluices is about the only guide that the average operator trusts himself to follow.

Of course, where the black sand contains gems or semi-precious metals in sufficient quantity to justify their concentration and subsequent extraction, the case is, as Abe Potash would say, "something else again, yet." For this reason the articles by Mr. Nicol have a special interest; and as he seems to have avoided most of the reefs that have strewn the black-sand shores with so many wrecks, it is possible that our friend, the misguided alluvial miner, may be led to the adoption of some of the methods he advocates, provided, as he wisely says, that there is anything in the sand. The great majority of Californian hydraulic mines, however, in my opinion, belong to the class in which "only a mass of black sand with a little associated fine gold would be obtained."

To return to your statement regarding "the weird discrepancies between drill-hole results and shaft-sampling," I am of the opinion that there lies therein a profitable field for discussion, and I hope to be able as soon as I have time to contribute another article which will give the results of my own experience with this.

Chas. S. Haley.

South Fork, Trinity river, June 23.

Classification of Technical Literature

The Editor:

Sir—The Joint Committee on Classification of Technical Literature is extremely desirous of obtaining the assistance of your readers in making a collection of classifications of applied science which have been developed independently in the offices of manufacturing plants or engineering firms, especially those which exist in manuscript form, and have been used for filing or indexing data. The Committee would especially like to have copies of any extensions of present systems to cover any special industry or branch of engineering not now fully covered by the published classifications.

W. P. Cutter, Secretary.

29 West 39th St., New York, June 21.

Flotation at the Inspiration Mine, Arizona

By ANOTHER OCCASIONAL CONTRIBUTOR*

The Inspiration Consolidated Copper Co.'s mine near Miami, in Arizona, is estimated to contain 97,143,000 tons of 1.63% copper ore, mostly in the form of chalcocite. The ore at present being mined contains about 0.20% metal in the form of carbonate and silicate.

For some time past the company has been experimenting with a view to finding the best method of concentrating the sulphide ore before smelting. The first test-mill consisted of two sets of rolls, one Chilean mill, one Hardinge conical mill 6 ft. diam. by 12 in. cylinder, Richards hindered-settling classifier, Deister tables, some kind of vanner, and a 50-ton Minerals Separation flotation machine of standard type (Hoover's single-level apparatus). This mill was situated close to the Joe Bush shaft, on top of the orebody, and is now dismantled. It is understood that good results were obtained.

On a change of management taking place, a new test-mill was erected near the old leaching plant of the Black Warrior Copper Co., about 1½ miles from the new twin-shafts through which all ore will be hoisted when the large mill is running. This mill will be the largest, or rather will handle the largest tonnage, of any mill in the world, namely, 15,000 tons per day. It adjoins the test-mill as can be seen in the photograph published in the MINING AND SCIENTIFIC PRESS of May 29. The crushing and concentrating capacity of the test-mill is about 1000 tons per day, but it is limited by the capacity of the classifiers, elevators, etc.

The ore is at present hoisted through the Scorpion shaft and broken in a 'K' Gates crusher close to the shaft. From there it is conveyed to the 30,000-ton flat-bottomed steel and concrete bins attached to the crusher-station at the new shafts. It is then transported to the test-mill in Ingoldsby dump-cars (each having a capacity of 60 tons) drawn by steam-locomotives on a standard-gauge railway. A part of the new mill-bins (which are of steel and trough-shaped) is set aside for the use of the test-mill. On leaving these bins the ore falls upon a tray-conveyor, then to an inclined rubber-belt conveyor, where it is automatically weighed. At the head of this conveyor there is a magnetic pulley that removes pieces of iron and steel which may have got mixed with the ore. At this point there is a grizzly and a 36-in. Symons vertical-disc crusher. (This machine was described in the PRESS of May 22, page 820.)

From here an incline-conveyor carries the ore to the top of the test-mill, where it is divided into two streams, one going to a shaking screen from which the oversize falls into a 48-in. Symons horizontal-disc crusher, where it is crushed dry, and the other to a 5 ft. 6 in. by 8 ft. diam. Marcy ball-mill, where it is crushed wet without previous screening. The product of the Symons machine is fed to pebble-mills without any classification, being distributed in varying proportions by a mechanical device. This consists of a fixed horizontal circular vessel 103 inches in circumference, divided into four sections by vertical sheet-iron partitions that can be adjusted to give segments of any size, thus varying the feed to each mill as desired. By measuring the number of inches of circumference given to each division the proportion of feed going to each mill can be calculated. Above this receptacle there is a vertical crooked revolving iron pipe through which the feed comes from the Symons machine after being mixed with water. The revolution of the feed-pipe causes the pulp to be discharged into each division of the distributer in turn. In the bottom of each division is a hole through which the feed passes to launders leading to the pebble-mills.

The following kinds of pebble-mills are installed:

1. One 20 by 6-ft. Chalmers & Williams quick-discharge tube-mill with herring-bone gear engaging with pinion on a shaft directly driven through a flexible coupling by an electric motor.

2. One Hardinge conical mill, 10 ft. diam., with cylindrical part 28 in. long, driven through spur and pinion by two-belt transmission from motor.

3. One Hardinge conical mill, 8 ft. diam., with cylinder 72 in. long, with herring-bone gear engaging with pinion on shaft direct driven by motor.

4. One Hardinge conical mill, 8 ft. diam., with cylinder 36 in. long, driven in the same manner as No. 3.

5. One Hardinge conical mill, 8 ft. diam., with cylinder 44 in. long, driven in same way as No. 3 and 4.

Both silex and El Oro linings were tried in the cylindrical part, and pebbles set in cement in the conical part; and, in one mill, steel plates, which, however, did not last long.

Each pebble-mill has a drag-classifier attached, and the oversize in the product, except in the case of the tube-mill, is returned by a bucket-elevator to the mill from which it came. In the case of the tube-mill the oversize is returned to the mill by the drag-classifier, which is parallel with the mill. Both Danish and Californian pebbles have been tried.

The product of the Marcy ball-mill is classified in a Duplex Dorr classifier, and the oversize returned to the same mill. This mill has a capacity as a fine crusher of about 13 tons per hour. Of the final product only about 1% remains on 48 mesh. This mill is simply a strongly built cylinder supported on trunnions, contains about 10 tons of chrome steel or manganoid balls, and is revolved at 22 r.p.m. It was formerly fed through the trunnion,

*As this article deals with the subject of rival flotation processes, over which a thick veil of mystery is supposed to hang, the writer thinks it best to remain incognito.

then three scoops were attached, but now one large scoop is used. It is lined with manganese-steel plates and driven through spur and pinion by belting from a 200-hp. motor, using about 140 kilowatts. The discharge is at the opposite end to the feed-inlet and passes through grates composed of steel bars placed close together. The discharge area is more than half the entire end of the mill. It will thus be seen that it differs essentially from the Krupp ball-mill, in which the screens are placed around the periphery and the pulp has to pass through two screens before escaping. The pulp leaving the ball-mill contains about 40% of moisture. This is diluted before entering the Dorr classifier. The overflow from the classifier consists of 2½ to 3 parts of water to one of ore.

The power required to drive these different mills, their capacity, consumption of balls, pebbles, and liners are, of course, known only to the management, but it is significant that in the new mill all crushing will be done by Marcy mills.

Among other crushing machines that have been tried are the Bradley roller-mill, Symons roller-mill, Overstrom mill, and Allis-Chalmers hammer-mill. No rolls or Chilean mills, Krupp mills, or Marathon mills were tried in this plant.

The products of the Marcy mill, and such of the pebble-mills as are running, are united and elevated sufficiently high to flow to all the flotation plants without undergoing any preliminary table or vanner concentration. The feed is distributed to the flotation plants in the following way: It flows into the centre of a horizontal, circular, revolving apparatus of sheet-iron divided into five concentric circles or rings. Each circle has 20 holes in the bottom, and the proportion of feed to each flotation plant is regulated by opening the proper number of holes and allowing the pulp to enter a launder along which it flows to the flotation plant. Thus if the ring that receives the feed intended for one particular plant has 15 holes plugged and 5 open, this plant is, of course, receiving 25% of the total feed, and the actual tonnage passed through it can be calculated.

Automatic samplers, worked by a water balance, are used throughout the mill. All assays are done by the electrolytic method, using rotating anodes.

Most of the flotation 'oil' is added to the pulp at the head of the mill, being fed from a tank by a small bucket-elevator driven by a shaft having a cone-step pulley, so that the speed of the elevator and the quantity of 'oil' can be varied to suit the tonnage of ore being crushed. This is much more satisfactory than letting the 'oil' drip from a can. Any additional reagent that may be required is added at each flotation plant by dripping from a can.

The following methods of flotation have been tried:

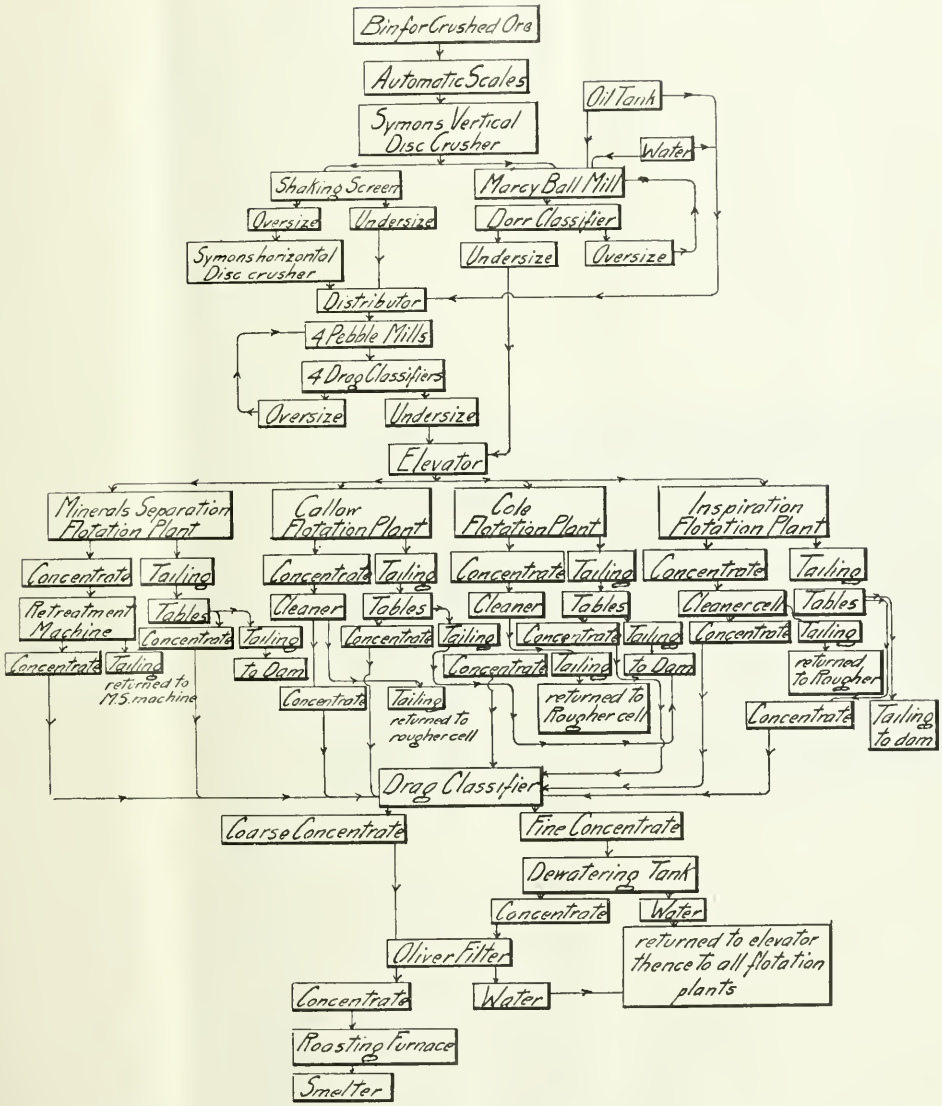
1. An 8-compartment Minerals Separation machine of standard type (as described in Hoover's book on flotation), having a nominal capacity of 600 tons per day. The agitation compartments are 3 ft. square, and the flotation compartments or spitzkasten, 5 by 3 ft. The spindles are driven through enclosed bevel-gearing by a pulley on a horizontal shaft. The overflow from the first six compartments was sent to the concentrate-bins without 'cleaning' or further treatment designed to raise the grade by eliminating insoluble matter and the overflow from the last two compartments was returned to the head of the machine. This machine was discarded.

2. A 12-compartment Minerals Separation machine of standard type, of the same capacity and driven in the same manner as No. 1, the additional compartments being intended to prolong the treatment. At first the concentrate and middling were dealt with as in No. 1 machine, but afterward the overflow from all compartments was 'cleaned' in (3), next described.

3. An 8-compartment 50-ton Minerals Separation machine of standard type, the spindles being driven by half-crossed belts from pulleys on a horizontal shaft. The overflow from all compartments was sent to concentrate-bins, and the tailing was returned to the head of No. 2 machine. This concentrate contained about 30% copper. These two machines were in use until recently.

4. An 8-compartment Minerals Separation machine of new type, known as a 'sub-aeration machine.' The agitation compartments were covered on top, and both mechanical agitation and compressed air were used. The agitation compartments contained cast-iron baffle-plates fixed to the sides, and the impellers were different from those used in the standard machine, but the spindles were driven in the usual way. The discharge from the agitation compartments to the flotation compartments was high up. The air used for the aeration of the pulp was introduced through a hole in the bottom of each agitation compartment at a pressure of about 2 lb. per square inch. It did not pass through any porous medium. This machine had the usual valves and suction-pipes in the bottom, but was afterward altered to (5) a machine of the Hebbard type, with agitation gear of the standard Minerals Separation pattern, but with horizontal discs in place of the usual screw-impellers. Each spindle makes about 300 r.p.m. In the Hebbard machine as used in Australia the agitators are driven from below. There are no spitzkasten, the overflow of concentrate-froth taking place from the agitation compartments. Consequently there are no suction-pipes and valves in the bottom, and no plugs to draw and replace when a stoppage takes place. The wooden partitions between the agitation compartments have been removed and cast-iron baffle-plates about 15 in. high substituted. Air is blown through eight holes in the bottom as in No. 4 machine (described above) and water under pressure is used to prevent pulp from entering the air-pipe. On a feed of about 300 tons per day this machine has given good results, and is still in use. The low-grade concentrate made by this machine is 'cleaned' in another machine of standard type.

6. A Towne-Flinn plant, or bubble-column concentrator with a nominal capacity of 50 tons per day. This consisted of (1) Pachuca agitator in which the pulp was mixed with oil, (2) a cast-iron vertical cylinder with a bottom of carborundum. The oiled pulp is fed into the



FLOW-SHEET OF THE INSPIRATION MILL. THE ROASTING FURNACE FOR CONCENTRATE IS AT THE SMELTER, NEARBY.

top of this cylinder through a pipe that delivers it below the surface. Air at a pressure of 5 lb. per square inch is blown through the carborundum. Bubbles are formed, that adhere to the oiled sulphide particles, forming a froth overflowing at the top of the cylinder into a launder, whence it flows to (3) a similar cylinder at a lower level, where it is 'cleaned.' The tailing from the first cylinder escapes through a hole in the middle of the carborundum and flows through a goose-neck hose (by which the water-level in the first cylinder is regulated) to (4) another cylinder where it receives similar treatment and more concentrate overflows. This concentrate also is re-treated in the same cylinder as the concentrate from the first cylinder, and the tailing from this cylinder or 'cleaner' is returned to the Pachuca agitator at the top of the building by a centrifugal pump. The air is furnished by a Roots blower. This plant was dismantled.

7. A Callow plant consisting of (1) Pachuca agitator 18 ft. deep by 4 ft. diam., (2) five cells, each 8½ ft. long by 2 ft. wide, with nominal capacity of 50 tons each per day, (3) one cleaner-cell 12 in. wide, (4) one air-compressor, (5) one receiver, (6) Connersville blower with a displacement of 3.3 cu. ft. of air per revolution, (7) two 3-in. centrifugal pumps, (8) 30-hp. motor.

Mr. Callow's letter in the PRESS of May 29 fully describes his process, so I need not go into further particulars, except to say that during the past few months the plant has been run without the Pachuca agitators; but this is by no means advisable. This plant has been running for about nine months and has given better results than any other that has been tried here. Forty of these cells are being installed in the new mill.

8. A machine invented by David Cole, of Morenci, Arizona, consisting of rectangular sheet-iron tanks with pipes laid horizontally in the bottom. The upper half of these pipes is composed of carborundum, and air from a blower is forced through them with the same effect as in the Callow, Towne-Flinn, and other pneumatic processes. Perforated wrought-iron pipes wrapped with flannel or canvas have also been used. The tailing from the first tank is re-treated, and the concentrate from all tanks is re-treated in a 'cleaner.' This plant is still running. A similar machine is in use at Morenci, and one is being built at Cananea, Sonora.

9. The company's metallurgist has devised an apparatus intended to combine the best points of the other machines but without infringing on any patents, except those of the Minerals Separation American Syndicate, from whom the company holds a license. It is called the Inspiration machine. At first it resembled a Callow apparatus with an almost flat bottom, the air being blown through canvas, but the froth overflowed at one side of the cell only, and there were partitions which, however, did not reach the bottom. It was twice as long as the ordinary Callow cell. The first concentrate was re-treated in a smaller machine of the same type, and the tailing from this machine was, as usual, returned to the 'rougher' cell. Recently other porous media for false bottoms have been tried. The machine is still in the experimental stage.

It will thus be seen that the company has spared neither time nor money in endeavoring to find the best flotation process. The test-mill has been working since January 1914, and about 50 flow-sheets have been tried. In the laboratory there are 6 small flotation machines of the Minerals Separation type in almost constant use.

The tailing from all the flotation plants is run over tables, those in use being Wilfley, Deister Machine Co.'s double-deck Simplex sand concentrator, Deister Machine Co.'s four-deck table, Deister slime-table, and Deister Concentrator Co.'s double-deck table. At one time the ore was concentrated on tables before going through the flotation process, but this was not found suitable for the Minerals Separation process, as it left too little mineral in the ore, and for this and other reasons it was discarded. The mineral saved on the tables is mostly pyrite. The 234 tables in the new mill are Deister Machine Co.'s double-deck type, the same as used in the Miami Copper Co.'s mill. No tests were made with any kind of vanner. The sand and slime were run over the same tables without classification, but this will be altered in the new mill.

The tailing from the tables flows to the dam, the retaining-wall being built by allowing the coarse sand to escape through cones or inverted pyramids attached to the tailing-launder.

The concentrate from all flotation plants and the tables, containing about 28% copper, 16% iron, and 26% insoluble matter, goes to a drag-classifier. From there the coarse concentrate goes direct to an Oliver filter and the fine to a V-shaped settling-tank, thence to the filter. The concentrate, after filtering, still contains a good deal of moisture. It is trammed to a bin adjoining a branch of the standard-gauge railway and loaded into bottom-discharge steel cars belonging to the International Smelting Co. Formerly it was sent to El Paso, Texas.

Water for the mill and domestic purposes is obtained by pumping from wells in the flat country about three miles distant. A large concrete reservoir has been built on a hill near the mill. Electric power is obtained from the power-house at the Roosevelt dam about 40 miles distant, belonging to the U. S. Reclamation Service, and the service is fairly satisfactory. The Inspiration company has an interest in the power-house at the International smelter near-by, where, in case of emergency, a supply of electricity can be generated by steam from waste heat from the reverberatories and from oil-fired Stirling boilers.

As mentioned in the annual report of the company (a summary of which appeared in the PRESS of May 1, 1915) 172,722 tons of ore was treated in this mill in 1914, so, although only a test-mill, it handles a fairly large tonnage. During the month of February last 90.3% of the copper occurring in the form of sulphides was recovered. The mill has been visited by mining men from all parts of the world.

C. E. Mills is general manager, Kenyon Burch is engineer, Rudolf Gahl is metallurgist, and G. E. Hunt is mill superintendent.

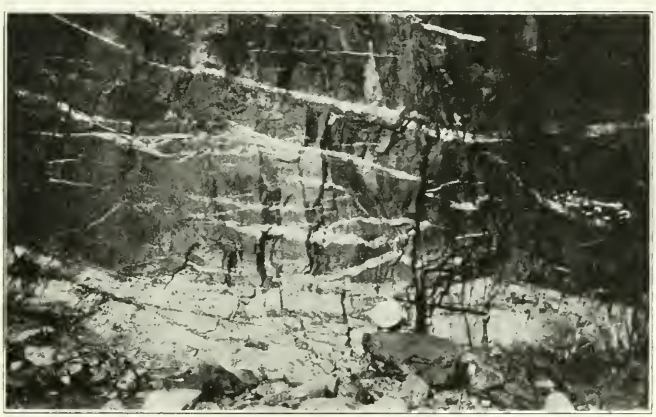
A copy of the flow-sheet at present in use is appended herewith.

Grass Valley Re-Visited—II

By T. A. RICKARD

The North Star vein has been followed to 6300 ft., which, on the dip of 23° north, is equivalent to a vertical depth of 2400 ft. Three of the four defined ore-shoots did not outcrop, but the discovery orebody was rich for about 700 ft. on the strike. The three ore-shoots that did not apex at the surface were found at 500, 1600, and 4000 ft., respectively. The North Star vein is remarkably continuous. Owing to a small repair in the Central, or vertical, shaft I was taken underground on the truck that runs down the old North Star shaft, which is an incline on the vein. This follows the vein for 6300 ft. and gives a good opportunity to remark its extraordinary continuity. It may pinch or widen, it may be a thin quartz seam or a mere parting, it may be a gouge-streak or six feet of solid quartz, but through all these vicissitudes the vein-fracture is continuous. The average of clean quartz is from 12 to 18 inches. The dip varies from a maximum of 45° to flat, but not in the shaft itself. Down to 4000 ft. the vein traverses diabase; below that it is enclosed within granodiorite. Here I may mention that the vein exploited in the Empire mine has been followed to 4800 ft. on the dip, or 2200 ft. vertical; in diabase down to 1300 ft., and granodiorite below. The North Star has several branches, some of them highly productive; for example, on the 3400-ft. level at the present time two of these, with diverse dip, are being explored and stoped. In places the fracturing in the diabase has produced a complex of veins requiring mining to be skillful in order that it may be economical. No marked cross-faulting is observable, but the lode-channel appears to follow an overthrust fault, causing overlaps and slips along which the healing mineral solutions have formed more than one duplication of quartz veins. Breccia and gouge are sufficiently plentiful to indicate that the vein follows a line of dislocation, as is further proved by the fact that the North Star displaces another vein fully 4 ft. in the western workings. On the 6300-ft. level, a large cross-vein (now the subject of controversy) has been cut and explored by a drift. It is most promising. The North Star vein has not yet been found or sought beyond this cross-vein, but it is proper to add that at 3000 ft. the North Star looked as if it had 'quit,' but it was found again, strong and profitable, for 3000 ft. more. At the bottom station a quartz-porphyry dike, 12 to 15 inches wide, is frozen to the granodiorite. This dike is cut-off by the North Star vein even where the latter looks feeble. Dikes of a similar character, but as much as 30 ft. wide, have been cut in the eastern workings of the mine. The miners call the quartz-porphyry 'marble' because it is smooth and hard-looking. Some good stopes went right through it; that is, the gold-bearing quartz was not interrupted by the dike, for the quartz-porphyry is pre-mineral although post-diabase.

Although large excavations have been made under the rather flat hanging wall of the vein, no extensive subsidences have ensued as yet, nor has the mine suffered from those sudden collapses of the overhang called 'air-blasts.' Something of the kind, however, must have happened in July 1912 when an area of about three acres fell, to the accompaniment of thunderous noise that lasted for about five minutes. No rush of air was noticed; indeed, the 'snuffs' left under the miners' dinner-buckets, heating the tea within, remained alight on the edge of the caved portion. The lights could be seen after the men had been extricated, but the buckets could not be recovered, the ground being too dangerous. A small hoisting-engine also had to be abandoned.



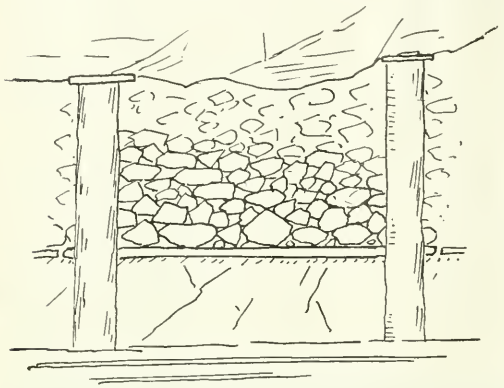
A TYPICAL STOPE-FACE IN THE NORTH STAR MINE.

The flatness of the stopes led to the invention, by the elder Mr. Foote, of a device for lowering ore along the foot-wall with the use of a gravity tram. This is the 'go-devil.' It consists of three sheaves on the same plane, one at each apex of an equilateral triangle, the wire rope passing round each in succession. The brake is applied by cramping a casting between the three sheaves, gripping all of them simultaneously.

In a mine so well managed, I saw one thing unworthy of imitation, and I may be permitted to make a note of it, as it was to be seen only in old workings. Nothing of the kind was to be observed in the newer workings. I refer to the use of a pole, behind two posts, as a base for

stope-filling, the face of the fill being upright instead of being founded on the foot-wall itself with a batter backward. The fill, being laid on a perishable timber, is bound to collapse when the timber rots.

Ordinary sampling is considered impracticable in a vein containing so large a part of its valuable content in



WRONG WAY TO FILL STOPES.

the form of free gold. The development faces are sampled only if no gold is visible. Samples are not taken even if the showing of gold is intermittent from day to day, particularly if the quartz contains "good-looking mineral," that is, lead and pyrite. The better grade of ore shows gold together with a heavy sprinkling of sulphides. If the quartz is white, without sulphides or visible gold, it is assumed to be poor—that is, waste. Quartz that is "white as a hound's tooth" is almost certain to be barren. The stope-faces likewise are judged by the eye; no samples are taken unless the ground appears to be so poor as to suggest discontinuance of stoping in any particular working. Instead of regular sampling it becomes necessary to establish a thorough system of supervision. Stope-bosses are employed to watch particular faces, not only to prevent the breaking of excessive waste, but to minimize the stealing of coarse gold. Usually three of these are on the pay-roll, besides three more 'specimen bosses,' one on each shift, whose duty it is to go through the workings and remove all patches of coarse gold, using a moil or hand-pick. They fill from 12 to 20 small sacks, weighing from 50 to 75 lb. each, per month. This stuff is worth from $500 to $2000 per month. Despite such precautions, there is a good deal of 'high-grading,' or theft. In addition to the six junior bosses mentioned, two special stope-bosses are supervising the 3400-ft. west workings, where a large crew is employed just now, so that 8 shift-bosses of this kind are on the pay-roll. The whole system of underground supervision, including the ordinary foreman and shift-bosess, entails a cost of 18 cents per ton, on ore yielding $9.50 per ton.

To break the gold-bearing quartz as clean as possible is the ideal, but it has to be adapted to economic conditions. At one time an effort was made to 'resue,' that is, to strip the vein on its hanging-wall side, but it proved unsatisfactory. The vein shows an increasing proportion of stringers as the mine is deepened and it is a fact that more of these stringers are now included in the ground stoped. Nevertheless the profit per ton has been nearly constant throughout the life of the mine, as the data in the table below indicate.

In preparation for stoping in the deeper portion of the mine, a new plant, to cost $78,000, is being erected at the Central shaft. This includes a steel head-frame, a hoisting engine, and a sorting annex. The hoist will be a Nordberg simple duplex engine of 28 in. diameter and 48-in. stroke. It will raise 4 tons at a rate of 1200 ft. per minute from 7300 ft. on the dip of the vein, that is, 2750 ft. vertical. The two drums will be 9 ft. diam.

NORTH STAR VEIN

Period	Source	Tons mined	Area mined square feet horizontal	Production	Tons per square foot horizontal	Yield Per ton	Yield Per sq ft	Remarks
1851-1861.	Surface to	25,000	.....	$500,000	...	$20.00	...	Lindgren, quoting Bean's Directory, says vein produced $250,000 from 1851 to 1857.
1862-1866.	600	35,000	.....	1,000,000	...	28.50	...	Estimated from Silliman's articles in Bean's Directory.
1867-1874.	600-1200	48,000	.....	1,125,000	...	23.50	...	Compiled from Clayton's report and Raymond's 'Mineral Resources West of the Rocky Mountains.'
1851-1874.	.....	108,000	643,000	2,625,000	0.17	24.00	$4.10	This gives production prior to North Star Mining Company.
1884-1900.	1200 west to 2300 west	148,049	750,000	2,634,795	0.20	17.80	3.51	Production of North Star Mining Company and North Star Mines Company.
1901-1911.	1100 east to 2700 east	182,224	561,500	2,759,220	0.325	15.14	4.91	
	2700-4400	683,634	1,327,000	.....	...	....	...	
1901-1913.	Development below 4000	63,783	.....	8,696,596	0.56	11.64	6.55	
1884-1913.	.....	1,077,690	2,638,500	14,090,612	0.41	13.07	5.34	
Total vein	.....	1,185,000	3,280,000	16,700,000	0.36	14.00	5.00	

with a 6-ft. face grooved. The engine will be provided with a Foster super-heater, to heat the air up to 370°F. The rope will be 1½ inch, made of plow-steel. The head-frame, 100 ft. high, is of structural steel, supplied by the Minneapolis Steel & Machinery Co. The weight is 96,000 lb. Ore from the mine will be discharged upon grizzlies, sorting out the fine, the remainder falling into steel bins, from which it will be fed to an oscillating picking-table. Between the feeder and this table the ore will be sprinkled to facilitate sorting.

In the repair-shop I was shown the device invented by the machinist, W. D. Paynter, for testing the drills used in the mine. It is a machine whereby the blow of a drill against a plunger is transmitted through oil to a diaphragm, the distension of which is amplified by a lever, at one end of which is a pencil that registers the force of the blow on paper laid around a revolving drum. For instance, a Waugh No. 50 drill on arrival from the factory was tested. Under an air-pressure of 95 lb., it struck 1932 blows, worth 25 foot-pounds, per minute. This was on December 9, 1914. After being used for 45 shifts the drill became ineffective underground and was brought to surface for testing by the Paynter machine.

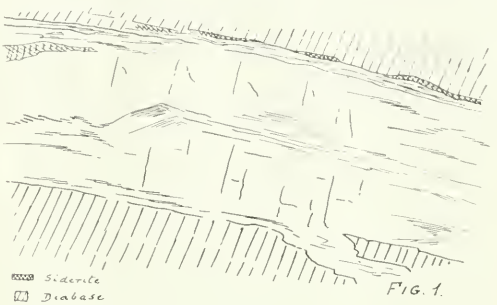
DIAGRAM OF DRILL-TEST.

Under the same air-pressure it now struck 2040 blows per minute, but only 15 ft-lb. per minute. This was on May 8, 1915. After being repaired, and a new 'barrel,' or cylinder, supplied, it struck 2220 blows worth 27 ft-lb. per minute. This also was on May 8. Whereupon it was returned underground in a state of first-class efficiency.

Another instance may be quoted. A year ago a new Ingersoll-Leyner No. 18 had been received at the Empire mine, where the men underground claimed that they could not get good service from it; it was condemned after it had been tried against an older drill. The discredited drill went to and fro from the mine to the repair-shop until finally it was sent for a test to Paynter, who endorsed its inefficiency. Whereupon a new drill, with a demonstrator, was sent by the manufacturer. This gave a good record on the testing-machine. By changing parts successively, it was ascertained that the valve-chest of the culprit was defective. When the valve-chest of the new machine was put on the old one, the results were as good as on the new one. The two cards are given above.* Thereupon the manager of the Empire bought one of the Paynter machines.

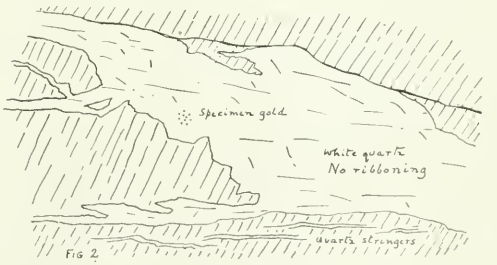
Of course, the use of such a testing-machine prevents unfit drills from being sent into the mine; it serves to discover weak spots, to cause prompt repairs and replacement of worn parts. The cost of operating drills, that is, the labor of the driller, air for power, maintenance of air-lines and of the drills themselves, steel consumption, sharpening, and distribution, altogether amounts to $100,000 per annum or one-third the total mining expense, which means the cost of breaking the ore and delivering it into the mill-bins.

At the North Star the Water-Leyner No. 8 (with 1½-inch hollow steel) and the Waugh 12-A (with 1¼-inch



A TYPICAL SECTION.

cross-steel) are in general use. The latter is being discarded for the Ingersoll No. 26, a hammer-machine of the column-mounted type equipped with a butterfly valve and using hollow (⅞-in. hexagonal) steel. It is found that the speed of drilling is more nearly proportional to the number of blows than to the force of the blow. With the big steel and a 2¼-in. bit the most effective blow is one of 45 ft-lb.; beyond that point the effectiveness of the drill is not progressive. The Water-Leyner with a 2¼-in. bit will drill 0.2 ft. per minute



A RICH SPOT IN THE VEIN.

under 1300 blows of 45 ft-lb. each per minute, while the Ingersoll No. 26 will drill 0.25 ft. with a 1¼-in. bit, 2200 blows, and 18 ft-lb. per minute.

The old Cornish pump must not be overlooked. It has been running steadily since 1884. The rod is 2400 ft. long, made of wood spliced together at 20-ft. intervals with iron straps. The column starts with a diameter of 16 inches and is reduced successively to 6 inches at the bottom. The 'bob' was made for the Potosi mine on the Comstock, and was then used at the Scotia, before it

*See also MINING AND SCIENTIFIC PRESS, August 2, 1913, and 'Tests of Rock Drills at North Star Mine, California,' by Robert H. Bedford and William Hague, Trans. A. I. M. E., 1914.

came to the North Star. The pump-rod weighs 155,000 lb. and is balanced, of course, by the bob.

Of late there have been rumors, well founded, of a conflict of apex-rights over the vein cut on the bottom level of the North Star. This vein dips from the opposite side, that is, from the direction of the Empire mine. Hence the possibility of litigation. It would not be proper for me to express any opinion on the matter, even if I were well informed concerning all the facts, which is far from being the case, but I do appreciate that the poor 'apex law' is again in danger of being stultified, for in the Grass Valley district the veins are so numerous, and interlocking, and their apices on surface so often non-existent, that the adjudication of mining-rights is beyond the judgment of man. Having regard to the sagacity of the owners of both properties and the ability of their advisors, both legal and geological, I have every hope and expectation that litigation will be avoided.† It is true that a minor newspaper stated that the North Star had offered to buy the Empire for $5,000,000, but that the offer had been countered with a demand for $7,000,000. This little story may be disregarded. Each mine has ground enough, and equipment sufficient, to constitute a first-class economic unit.

Leaving this delicate topic, let me close my notes by a reference to the amenities of the place to the pine woods, the pleasant houses that they shelter, and the earnest technical men, and their accomplished wives, who find a home there. At Grass Valley life has lost the uncouthness of a frontier settlement. The second growth of pine has clothed the bareness of the hills, from which the pioneers stripped the tall timber. Now an adult forest has risen among the old stumps. The ground is carpeted with the brown needles. A clearing gives a glimpse of the snowy peaks of the Sierra Buttes silhouetted against the blue. Sunshine in golden lanes falls athwart the forest spaces. Quiet reigns. Only the muffled roar of the stamp-mill comes as a reminder of the resourceful energies that are ever at work in the depths underground.

The Missouri is the muddiest river in the Mississippi Valley; it carries more silt than any other large river in the United States except possibly the Rio Grande and the Colorado. For every square mile of country drained it carries downstream 381 tons of dissolved and suspended matter each year. In other words, the river gathers annually from the country that it drains more than 123,000,000 tons of silt and soluble matter, some of which it distributes over the flood plain below to form productive agricultural lands, but most of which finds its way at last to the Gulf of Mexico. It is by means of data of this kind that geologists compute the rate at which the lands are being eroded away.

Talc and soapstone production in the United States in 1914 was 151,088 and 21,208 tons respectively, valued at a total of $1,865,087.

†This anticipation has proved, I regret to say, optimistic. Legal proceedings are now pending.

Terne Plates

This item of manufacture has come into prominence as a substitute for galvanized iron in roofing and outdoor protection. The terne plate is a sheet of iron coated with a mixture of lead and tin, the proportion of these two metals varying from 15% tin to 25%. The tin is said to cause the lead to adhere to the black sheet of steel. Owing to its greater cost, the manufacturer uses as little tin as possible. In regard to the merit of terne plates as compared with other coated sheets, it would appear that it depends upon the weight of the coating. As commonly quoted, this coating ranges from 8 to 40 lb. per box of 112 sheets, each of 20 by 28 inches. Thus the 8 lb. of alloy is spread over about 800 square feet. It follows that a mere scratch will expose the steel to corrosion. It is a curious fact, moreover, that 0.15 to 0.25% copper in the steel will increase the resistance to corrosion. The two metals form an alloy. Those in the trade say that a 30 or 40 lb. coating should be used if terne plates are to equal galvanized sheets in efficiency. The best proof of the superiority of galvanized sheets is the growth in the use of them. Painted black sheets were widely used at one time, but they have not the vogue of a few years ago. On the whole, consumers are loath to use any substitute for galvanized iron and will pay the higher prices, provided they are not prohibitive. Probably the prejudice against the old-fashioned 'tin roof' is due largely to the variable composition and quality of the coating used. In order to overcome this prejudice some organized effort toward standardization is necessary.

Gold-Mining in Ssu-Chuan

Gold is found in many places in the province of Ssu-chuan, China, and the upper reaches of the Yangtze are known by the natives as the Kin-ho, or gold river. Alluvial gold workings may be seen along many streams; near Ta-chien-lu, for example, 500 or more men are at work. The most important lode mine so far found is at Maha, in the southwestern part of the province, about 50 miles northwest of Ning-yuan-fu. Work on the mine was started some years ago, but on account of revolutionary disturbances not much has yet been accomplished, although several large and productive veins have been found. Two Chinese engineers who have studied in Belgium are now in charge of the property, and some 1200 men are employed. Funds for financing the work of development have been provided by the Government and it is the intention to purchase the necessary equipment in America.

Drilling efficiency depends upon the following factors: (1) knowledge of the rock; (2) the selection of a machine-drill that is suitable for the work in hand; whose dead time in handling and mounting is low, and that is capable of keeping pace with the drill bit, and (3) a study of the suitability of drill-bit.

Mining in Utah

By L. O. HOWARD

The recent flurry in the lead market has stimulated local inquiry as to the possibility of increasing the state's production of this metal. Aside from the excellent position of copper, a rise in the price of lead and silver evokes the greatest interest, inasmuch as the production of these metals comes from a wider area, and as Utah is surpassed by but two states in the production of lead and its ores, and by but one in lead-silver ores.

As is well known, the major part of the lead-silver production is made by the mines of Bingham, Park City, Tintic, and Beaver county, the first two contributing sulphides and the latter two shipping most of the carbonate tonnage of the state. Much of the ore from Park City and Bingham is in the form of a concentrate, that from the former, particularly, carrying considerable zinc, most of which is lost in smelting, except in those ores or concentrates that are amenable to electrostatic separation, and which are so treated at one of the Salt Lake valley plants.

As to the possibility of increasing the mine production, it is to be expected that Bingham and Park City can largely increase their shipments, although the uncertainties of the market have operated to prevent a too hasty expansion of the scale of operations. In the near future we may look for a greater output of the finer concentrates from both districts, a large producer in each being on the point of installing a flotation process.

In the Tintic camp there has been some increase in the number of men employed and in the number of leases taken up, both underground and on old dumps.

With lead under four cents, producers of sulphide ore have of necessity depended on the silver content of their ores for any appreciable profit and it can be easily understood that a price for lead that would enable consistent profits to be won from that metal would be most welcome. Producers rather prefer a price of five to six cents, justly believing that a higher price is likely to lead to later demoralization of the market, through discouraging the use of lead where it is not essential.

In considering the position of the smelters it is evident that too high a price will operate to limit ore-purchases to those made under contract or otherwise most desirable, since it would not be sound business to accumulate any stock of ore in excess of smelting requirements, in the face of a possible quick decline in the market. So that the final limit to an increase in production will naturally depend on smelting capacities.

It is always difficult to give accurately the capacity of lead-smelting works in terms either of lead ore or lead bullion, on account of the variable nature of the materials charged, for a considerable portion of the charge may consist of ores valuable for their gold and silver content, with lead at a minimum; and it may not be and is not likely to be practical to treat only ores high in lead, in order to take advantage of temporary high prices. But using as a basis of approximation the average charge smelted and omitting consideration of any increases brought about by better metallurgical practice, or other favorable factors, an approximate estimate is possible, which will serve to point out at least the direction in which the limitation lies.

Fourteen out of a total of 19 lead stacks are now in operation, treating approximately 3500 tons of charge daily, out of a possible furnace-capacity of about 4750 tons, or at about 75% of capacity.

Inasmuch as fully two-thirds of the ore is roasted, it is evident that unless there was a large increase in receipts of oxidized ores, the roasting equipment might determine the limit of capacity. This equipment could not be increased generally without increasing flue-systems, bag-houses, etc., and would not be considered while the market was unsettled. As near as can be estimated there are in operation the equivalent of 12 Dwight-Lloyd sintering machines, out of an installation of 16, sintering about 1800 tons of charge daily, out of a possible capacity under present operating conditions of about 3000 tons. There is also further sintering capacity in the shape of Huntington & Heberlein pots, capable of treating an additional 400 tons of charge daily. Without making any arbitrary assumptions as to the amount of lead ore on the charge, the above figures give the relative proportions of present and possible capacity, which is all I wish to emphasize in this review of conditions.

Should furnace and roasting capacity be in harmony, the one or the other might be mentioned as marking the limit, but it happens that at one plant with furnaces idle, roasting equipment is all in operation while at another all blast-furnaces are operating while part of the roasting plant is not operated. This, then, limits the possible increase in the charge to a few hundred tons per day, and as higher prices call out lower-grade ores, it is questionable whether the lead on the charge would be greatly increased.

A factor of no little moment in connection with the treatment of greater tonnages of sulphide ores is the limit placed on such increase by the Courts as a result of certain smoke suits against some of the smelters.

Taken in all its aspects the threatened high price for lead has again emphasized the desirability of the producer selling his ore under contract. One clause favorable to the smelters, which is generally lacking in lead contracts in this market, but is in frequent use in zinc contracts, is a provision that enables the smelter to share in increased profits from higher prices, through automatic increases in charges with increased prices. As it

is, the same smelting charge is made, whatever the price of lead. A tendency to get some of this increased profit is manifest in the reported payment of only one-half the advance over 4½ cents, on ore bought in the open market recently. This, of course, does not affect present contracts. While smelters may anticipate enhanced profits from ore now in stock bought at low prices, there is little to be hoped for in the way of extravagant profits on ore bought at high prices, as the decline following a rising market is usually rather sudden, while the effect of increasing prices is but slowly cumulative, as it relates to the favorable side of the smelter's balance-sheet, and it is not an attractive proposition to carry metal bought at high prices for the sixty or ninety days that may be necessary to beneficiate it and market it.

One source of helpless grief to local smelters is the high content of some of the ores in zinc. That this grief is not illusory is evident in the present high price for a product that these plants must waste. To throw away a metal worth in the neighborhood of 25 cents to save another worth 5 or 6 cents surely gives rise to a feeling that elicits our sympathy.

It did not require, however, the stimulus of high prices to create a widespread spirit of research into methods that might save this zinc, in which effort Utah is not at all backward. A discussion of this phase of the subject must be postponed for the present.

There is not much activity looking to the improvement of milling conditions. Operators are not slow to see the possible advantages in flotation processes, and, in spite of hampering litigation, substantial progress is being made. When the new Callow plant is installed at Park City, two of its four milling plants will be equipped with flotation apparatus, and the Utah-Apex at Bingham will mark the third installation of flotation in silver-lead-zinc mills, of which there are but five of any importance in Utah. Of importance also in the treatment of the silver-lead-zinc ores is the proposed large increase in the capacity of both the wet and dry (electrostatic) mills of the United States smelting company at Midvale, which may go into commission in the next sixty days.

The favorable price for copper has brought about the complete recovery of this business from the early depression of wartime, and has also aided to repair certain disastrous conditions that existed previously to that depression. There is not the same relative opportunity for betterment to the small producer of copper ores that exists for the lead producer, since, although there are some small producers of copper and several large producers of lead, the larger part of the copper production comes from big-scale operations, while many smaller producers and lessees aid in swelling the lead output.

The copper price, however, lends effective aid to the exploitation of the low-grade ores of the Ohio Copper Co., which is to be undertaken by Salt Lake, Butte, and New York interests. The profit accruing to this company from unsold copper, tied up some months ago when prices were low, has added a large amount to the assets of the company and it is hoped that the favorable combination of circumstances will place the mine upon its feet once more.

Nor has activity in the search for precious metals been lacking. Discoveries of rich specimens of gold ore in the Bull Valley district near Modena has lead to an increased output of interested boosting in the daily press, but in lieu of authentic and definite statements of footage and grade of ore, and demonstrated continuity of ore with depth, conservative men are withholding judgment. A fair sized boom is on.* Exceptional specimens have been found in fractures in the limestone. The high-grade ore is itself mineralogically remarkable, occurring in a well crystallized calcite. The lower-grade is found in or near porphyritic intrusions, so highly altered as to obscure their nature. The locality appears promising in so far as the milling of $5 to $20 ore is concerned. There has been too little development, however, to permit a confident judgment as to its importance. Only recently a piece of rock containing a large amount of free gold was reported to have been found near Quail Springs, some three or four miles from the pioneer prospect of the district, the Hamburg, where the first work was done about eight years ago. The mineralized area may have an extent of six to seven miles by three or four miles. One company is reported to be driving a cross-cut adit which will cut its vein at a depth of 800 ft. below the outcrop.

At Park City some progress is being made in treating the low-grade silver-lead ores of the American Flag by the chlorination process used at the Park City Mills plant. A capacity of 30 tons per day has been reached with the new Holt-Dern roasting furnace, and it is expected that this can be doubled. At this capacity expenses are being cleared. The ore carries 18 oz. silver and $2 in gold, a little copper, and some lead, but not enough to be recognized by the smelters in settlement-sheets. Silver extraction is satisfactory and lead and copper are saved, but the gold extraction has not yet come up to expectations, and a lot of pioneer work has been necessary, since the original plant applying this process on the Ontario stope-fillings did not have to extract the gold. This latter mill is being dismantled and will be re-erected in place of the Knight-Christensen mill in the Tintic district which was destroyed by fire before reaching wholly satisfactory operating conditions. With the opportunity to erect a plant to suit the process, rather than being under the necessity of adapting an old plant, interesting results are expected. The plant as finally operated at Park City earned a profit, but the new arrangement promises a better ore-supply.

One of the first steps looking to the utilization of the potash (alunite) deposits of Marysvale is the awarding by the Minerals Products Co. (said to be affiliated with the Armour interests) of a contract for a portion of its aerial tram from the deposits to the railroad. So the addition of another to Utah's already diverse mineral industries seems to be well under way.

*References to this discovery appeared in our issues of June 5 and June 12.—Editor.

Speculation in Mines

By F. LYNWOOD GARRISON

This is a topic that may be viewed in many different ways. Speculation or gambling is a primitive instinct, and in its crudest forms is a common practice among savages. Civilized man may check and cloak his primitive impulses, but the world of today is painfully aware, as perhaps never before in modern times, how little progress the white race has actually made in this respect.

The word 'speculation' is thus defined in the Century dictionary: "To invest money for profit upon uncertainty; take the risk of loss in view of possible gain." And 'gambling' is stated to mean: "To play any game of hazard for a stake; risk money or anything of value on the issue of a game of chance, by either playing or betting on the play of others; hence to engage in financial transactions or speculation dependent for success chiefly upon chance or unknown contingencies." It is evident that there is no great difference between the one meaning of the two words.

Mining, especially metal mining, is usually regarded as speculation. It is certainly not often a proper sphere in which to invest the widow's mite or the orphan's portion, but it is surely an attractive and proper field for the vigorous man with plenty of red blood in his body.

Now in one conception a mine never produces anything: it creates nothing in the sense of a farm yielding crops. It is the storehouse, if you please, containing an undefined and unknown amount of treasure, or what may be such if it does not cost more to take out than the product is worth in the market. In other words, a mine is what actuaries term a liquidating or wasting asset. Every pound of ore taken from a mine makes it just that much less valuable. Actually the taking of ore from a mine might make it more valuable because the act of doing this may develop the property and show resources theretofore unsuspected. Indeed it is seldom possible to be sure when a mine is completely exhausted, and what is waste-rock today may be ore tomorrow by reason of changed conditions. We certainly cannot expect the investor to view and understand such matters in the same way as an experienced mining engineer; the trouble is, the investor often thinks he knows as much, or even more, than the engineer.

When the Tonopah mine was discovered in the early part of 1901, Nevada as a mining region was as dead as Herod. Probably if the exploration companies that are today advertising for mining properties, but never appear to purchase any, had been then in existence, they would have appended to their advertisement "nothing wanted in Nevada." I well remember when the Tonopah mine was first brought to Philadelphia. The chief backer of it offered me some stock at a very low price, and when I asked him who was their engineer, he replied that they had, and needed, none. For that reason the proposition did not appeal to me; I failed to purchase the stock, and missed getting a good thing. My position in the matter was wholly logical and sound; most companies that undertake to mine without an engineer come to grief, but in this instance an engineer was really not absolutely necessary, for the mine at that time was too rich to be spoiled by any amount of bad management. It was in fact, a rank gamble, but successful; and it subsequently had a host of neighboring imitations, most of which ended in disaster.

The effect upon the public mind of such fortuitous ventures is on the whole distinctly bad: a crop of irresponsible promoters springs up and almost any old hole in the ground may be financed if presented with sufficiently alluring statements and literature. The eternally young-old game of getting something for nothing has an irresistible effect upon the human mind at such periods. It is a species of insanity, and we have had many instances of it in the history of the country since the days of the California gold rush in 1849. The psychology of public opinion is often inscrutable, but on the whole when allowed free and unhampered expression is generally right, if not perverted by greed, suspicion, and misinformation—a trio of faults one might suppose modern civilization had done much to dispel. It is perhaps needless to expatiate further upon human frailties; we all have our share of them.

The important thing in mining ventures is to discount the inherent risk and in doing this the public should be brought to recognize that mining, especially metal mining, is a highly technical business, and that to place such a business in untrained hands is to court disaster. The fact that there are not a few instances in the history of the country where men perfectly ignorant of minerals, rocks, and mining have discovered valuable ore deposits and become rich thereby, is no argument to the contrary. Mere chance or fortuitous circumstance is no proof of knowledge or skill. These remarks are so self-evident and trite, one almost hesitates to make them, but they contain homely truths that cannot be too often reiterated.

The cardinal principle in mining is to consider that such a venture or investment is never perfectly safe until the original amount involved has been equalled by the total dividends received. Moreover, it should be clearly understood that until this stage is reached the dividends do not represent profit but a proportionate return of the principal invested. A disregard of this precept is a common error, especially with women. It cannot be too often repeated that a mine is a wasting asset that necessarily becomes less and less valuable as it is worked. It is, of course, ordinarily impossible for an investor to know when the mine is likely to be exhausted. The engineers in charge may be able to approximate closely the period when this may be expected, and through them, of course, the information should reach the directors, but

the directors do not always share their knowledge with the stockholders. A surprising thing about the mining business is the tenacity of life of some old properties. Sometimes they are supposed to be completely worked out, when new orebodies are found; or, in other instances, ore previously too lean to be worked may later become a valuable asset by virtue of improved mining and milling methods. Then again, old tailing-dumps may be reworked to yield a substantial profit or the mining company may have accumulated a substantial surplus that can be invested in a new mine, thus maintaining the value of the stock. These observations tend to show that the mining investor is nearly always at the mercy of the managers of the property unless he be himself a skilled miner and has opportunities of examining the property.

In theory at least a mining company should not issue mortgage-bonds on its mines, or at any rate their term should be so short as to be well within the probable life of the mine.

The most important factor in financing a mining enterprise is one rarely given sufficient weight, that is, establishing ore reserves. It goes against human nature to see thousands of dollars put into the ground when not one cent is coming out; the average investor can seldom appreciate the logic and soundness of such a course of procedure. Herein, thus expressed in simple terms, lies the essential difference between absolute speculation and investment; obviously money spent on a mine when there is no definite and certain knowledge as to what amount of ore may be taken out, is speculation; whereas, suppose we have a million dollars worth of ore blocked out in a mine and we know for a fact that it can be taken out, milled, and turned into money for a cost of say $600,000, yielding a net profit of $400,000. It is evident that any amount put into the mine not to exceed $400,000 is an investment, and as a speculation it is logical to suppose that this same mine which produced a million dollars of ore will very likely yield considerably more.

I am convinced that we can never hope to persuade the general public to accept this view of mining. Men in general regard metal mining as a gamble and business people who are absolutely sane in their everyday affairs are ready in 'good times,' when money is plentiful, to listen to the tales of the irresponsible promoter, the fake 'mining expert' and the irresistible lure of getting rich quickly. When times are 'hard,' as at present, the promoter of this class with his bedfellow 'the expert' are hibernating somewhere, patiently waiting for better days to come when the tradesman will have a little spare cash to throw his way. Anyone who has not had actual experience with such matters could hardly believe the credulity and crass stupidity of many seasoned business men when carried away by the delusive blandishments of these fantastic schemers.

Far be it for us to discredit and discourage the honest and decent man who seeks capital to promote a meritorious and attractive mining proposition. He has a hard row to hoe at the best of times because he hesitates to distort the truth or minimize the risk, and if he fails to sing a sufficiently alluring song the money will be shy, but once let him pipe the right tune, the dollars become nimble and flock like sheep to be led where and when he pleases. If the promoter can once convince a man he may get something for nothing, there seems to be no limit to the folly of which human beings may be guilty.

No business depends more upon accuracy of judgment and sound technical knowledge than that of mining in all its branches. The mining engineer must not only be well versed in the intricacies of his profession, but amply endowed with imagination, that he may be equally able to determine what is based upon fact and what is mere fancy, and, what is more important, the limits to which it is safe to let imagination carry him.

Honesty and frankness are absolutely essential in the engineer; the would-be investor must be neither discouraged by pessimism, nor allow optimism to lead him astray; yet, if the picture be painted in too dark colors we may be sure the capitalist will button up his pocket and no risk be taken. The subject, therefore, resolves itself down to a dependence upon the engineer's sound judgment and technical accuracy. With large investments in unproved properties one engineer should be used to check another, no one man's judgment may be wholly trusted, and a careful engineer will himself seldom desire or permit such a thing to happen. But the capitalist should do his part also with the facts before him and his knowledge of the character of the men who have gathered them. The final decision must rest with him, he must weigh and consider most carefully the speculative elements free from cupidity, because in nine cases out of ten it is the lure of avarice that gets the better of his judgment.

It is pertinent in this connection to observe that the whole structure we call modern civilization rests upon the use of metals and they cannot be obtained except by mining. That the earth will continue to yield them indefinitely at the present rate no mining engineer of wide and mature experience will venture to assert. Rich deposits are becoming more and more rare. In the days of the Roman empire the streams and gravel-beds of Central Europe yielded considerable gold and at the same period the alluvial deposits of Cornwall produced the tin that made Tyre famous. The first historical fact has long since been forgotten, the lode mines of Cornwall many years ago eclipsed the stannaries of the ancients and now in turn these lodes have about been exhausted.

I cite these cases to show what we may expect in this country, large as it is, ever bearing in mind that the rate of production and consequent exhaustion is now vastly quicker than in Roman times. It is true the modern mechanical and chemical methods of ore treatment enable us profitably to mine low-grade ores that twenty, or even ten, years ago were of no value whatever. But it is doubtful if the limits in this respect are not now nearly in sight, unless the market-price of most metals materially increases.

The world's production of gold between 1912 and 1913 decreased $17,000,000, and in the year following $7,500,000.

Soetbeer computes the total production of gold in the

world since the year 1493 at $14,775,110,000, an amount about only one-third the estimated cost of the War in Europe if it lasts a year from August, 1914.*

The consumption of the gold in the arts is steadily increasing, and the demand for its use in commerce as a standard of value knows no limit. The logical conclusion from this review of general facts is that the price of metals must steadily advance; of course, there will be fluctuations, but the average level must tend to become higher as an inevitable result of the ever-increasing demand and the exhaustion of rich deposits with few new discoveries to take their place. The general tendency will be—indeed, it is already evident—for mining of all descriptions to segregate into the hands of large companies on the principle of large production upon small margins of profit but with an aggregate sufficient to yield a steady but relatively moderate return upon great investments of capital. The operations of such large companies are usually so diversified and distributed over a number of properties that the failure of one does not necessarily seriously affect the general business of the operating company as a whole. Hence the purchase of shares at reasonable prices in such organizations tends to become more of an investment than speculation. There is no doubt the segregation of mining operations into the hands of large corporations is a distinct advantage to the conservation of national resources. A large company, as a rule, is less wasteful than a small operator. It can afford to set aside its low-grade ores until such times as they may be worked at a profit, whereas the individual operator or small company can seldom do it, as he must look for immediate profit and pick out the rich spots, abandoning the rest as worthless, and often leave the mine in such condition that it cannot be re-opened.

As a check upon individuality, these tendencies are unfortunate. No country in the world has ever offered such opportunities for the development of the individual as has the United States and Canada. The time was, and not long ago, when the individual might discover an orebody, develop it into a mine, and become rich thereby. Such a possibility was obviously predicated upon the ore being rich and the operator having some small amount of capital; but we all know these opportunities are becoming more and more rare and are largely responsible for the cry "what is the matter with prospecting?"

The theme suggests other reflections, but I have said enough to show my own views concerning the speculative side of mining. The problems now presented to the young mining engineer are materially different from those we had to meet in our younger days 25 years ago. The fundamental principles of life do not conspicuously change, but the adjustment of the individual to shifting conditions demands constant attention, and the man who fails to adapt himself and blend gracefully with the current of events is not likely to achieve much or make himself a useful member of society.

Before concluding these few remarks some reference is appropriate to a few facts of timely and fundamental importance. The metal-producing industry of the world is chiefly in Anglo-Celtic hands. Germany, the greatest manufacturing nation of modern times, extracts from her own territory but a very small amount of the metals and has to depend upon importation to meet the rapidly increasing demand of metals for her industries.

Germany's metal requirements are met in two general ways: by importation of raw ores for treatment in her metallurgical establishments and by the purchase in outside markets of the crude metal itself. It seems curious that such a strong virile people as the Germans should evince so little interest in mining enterprises outside their own country, especially in view of the fact that an abundant supply of the metals is absolutely necessary to their continued prosperity. The only way I can account for this fact is that the Teuton is not a good sport, the mining game does not appeal to him as does trade and manufacturing, in which he no doubt opines the element of chance is a less important consideration. In South America and also in China one is forcibly struck by this view of German enterprise. The Teuton has been making tremendous strides in trade and his ships follow his trade, but seldom do we find him investing his money outside his own country in enterprises that are developing the natural resources of the places in which he is doing business, such as mines, railroads, power-plants, and the like. Trade is safer and the German has a ruthless genius for it.

As investors or speculators in mining enterprises the English are pre-eminent, they are ready to take more risks than even Americans, but at the same time they are prone to minimize these risks by employing good engineers whom they do not appear to hesitate in compensating generously. This fact, I believe, accounts in a large measure for the considerable number of American mining engineers who have been for years making their headquarters in London. Indeed since the early golden days on the 'Rand,' in South Africa, American mining engineers have been largely employed by British companies. But these conditions may not endure. Hence if we are to compete and continue to hold abroad the great reputation that American engineers have achieved, we must induce American capital to venture outside the borders of this country. Most Americans seem to have a notion that because a mine, or other investment, may be in a remote place, it is necessarily a precarious venture. There certainly is an indisposition on the part of American investors to incur the heavy expense of sending an efficient and responsible engineer to such places. The promoter is well aware of this weakness and works on it. Experienced mining concerns, of course, are not ordinarily guilty of the folly of such false economy, but the small syndicate, "our little crowd at the Club," once the plausible promoter gets the proper introduction, is very likely to succumb to the "practical miner" and believe his contemptuous references to the engineer, or what he usually prefers to denominate him, the "expert" or "professor," terms of approbrium of an ignorant and suspicious mind.

*See Report of Director of U. S. Mint, 1914, page 268.

*Edgar Crammond, Secretary Liverpool Stock Exchange, quoted in *The Outlook*, New York, April 28, 1915, page 972.

Mining Machinery Salesmen

By P. B. McDONALD

Every mining man knows several of them: intermittent callers keen to sell a new variety of rock-drill, an air-compressor, a hoist, a pump or two. Some of them the mining man is glad to see; he enjoys talking with them; others he dodges as adroitly as he can. All sorts and shapes they are, lean, bronzed, hatchet-faced fellows, fat, sleek, cigar-smoking men, young ones, old ones, wise ones, bold ones; grizzled veterans who have handled mining machinery all their lives, and who look upon the marvellous new drills, sharpeners, etc., as only incidents in a more or less changeable field, a natural enough development that is to be occasionally expected; enthusiastic young pushers who are overflowing with a professional argot and one-sided data concerning the wonderful devices that their company is bringing out, and who confide to you in a whisper that such-and-such a machine is not being advertised yet, because the demand is so overwhelming that the factory is flooded with orders, but that, as a special favor, they can get you a few of them.

Then, there is the 'expert' type. Slow-talking, ponderous dignified men, who let you see that they are straining a point or two to visit your old mine and advise you about your poor little bunch of machinery. This special type usually only comes accompanied by the regular district-salesman, being sent out from the head-office or factory for assisting on large installations or to clinch a much desired order. Some of them are impressive and interesting men to meet, who leave behind a feeling of confidence and satisfaction, men who tell you just the things you have long wanted to know in just the right manner to stick them in your mind. Others are great bores.

In the main, there are two sorts of salemen that the staff at the mine is glad to see. The elderly man who is a 'personality,' that rare, magnetic style of character which is less common now than a generation ago, men of known principles and acknowledged position who are good salesmen because they are likable and square. The other style of salesman that is universally welcome is the young or middle-aged man who really has something to say. One who informs, jokes, and understands conditions, but who does not bluster or bluff. This latter type of salesman may be a college man or he may not. Primarily he understands the machinery he sells and the men to whom he sells it. He knows how to explain to a mine superintendent or manager what they ought to know about the machinery they buy, without boring them or becoming tiresome. And he tells them other things that they are glad to hear, bits of this and that picked up in extensive traveling.

Some mining districts are found using almost exclusively one make of rock-drills, or pumps, or drill-sharpeners, due partly to the goods having merit suited to the requirements of the district, and partly to the personality of the district sales-manager.

In the copper country of Lake Superior, there was a salesman who got into a fist-fight with a miner as a result of a rock-drill demonstration; there are two or three who are famous for their 'Cousin Jack' dialect stories and are invariably invited to all banquets and festivals; there is one who is so generally liked on the Iron Ranges that mine managers and foremen in three states call him by his first name; and there is the usual sprinkling of Irishmen, some with this peculiarity and some with that.

In general it may be stated that machinery-salesmen are a younger class of men than formerly. With the advent of efficiency methods in mining, machinery is not bought so off-handedly as in the past, and the merits and demerits of different mechanical features are given careful consideration. At the same time, there are some mechanical features of which their principal advantage is that they give something to talk about or an excuse for tacking on an extra item in the price. Mechanical improvements and accessories can be overdone, particularly where the class of labor available for mining is of the temperament that believes that when a rock-drill refuses to operate the only remedy is to hit it with a hammer. Thus, young men introducing improved machinery and trusting principally to the attractiveness of the improved parts, will not always take business away from the older proved machines that, while perhaps less up-to-date, are quite satisfactory because they have been giving good results through varying conditions. There are yet miners and foremen who claim that the "old Rand slugger is the best drill of them all," in spite of its having been superseded years ago by drills that, in turn, have had their day, to be replaced by still later and faster models.

And personality is not yet dead. A mine superintendent is a very human individual; offered two machines of approximately equal merit, he will buy from the salesman who best typifies his idea of what a salesman should be. The personal qualities that count in the case of salesmen for groceries or dry-goods do not apply to the field of mining machinery, nor would the average successful hardware-drummer necessarily make a good man to sell in the mining trade. Mine superintendents, used to the peculiar exigencies of handling such balky and extraordinary problems as are involved in daily conflict with hard rock, ignorant laborers, and intermittent catastrophes, are little influenced by the arguments of men who may be excellent salesmen but know nothing of mining. A mining-machinery salesman should know something about mines as well as about machinery, and he should know about superintendents, foremen, and miners as well as understanding about warehouses and offices. He should be able to talk equally well a thousand feet underground with water dripping down his neck as in the manager's private office, and should get accustomed to conversations carried on while the other man is attending to such necessary duties as changing his boots, paying off drunken miners, or washing his face. Sometimes it is important to listen well; for knowing when to keep still may be more efficacious than much talking.

Geology of Gold Road District

By HOWLAND BANCROFT

Having recently examined some properties in the so-called Gold Road-Tom Reed mining district southwest of Kingman, Arizona, I again reviewed, and this time with more than ordinary interest, F. C. Schrader's report, 'Mineral Deposits of the Cerbat Range, Black Mountains and Grand Wash Cliffs, Mohave County, Arizona,' which report is known as Bulletin Number 397 of the United States Geological Survey, and was published at Washington in 1909. Mr. Schrader is to be congratulated upon the large area traversed by him on his reconnaissance in view of the short time at his disposal; and the detailed study which he gave to many of the properties is worthy of especial commendation.

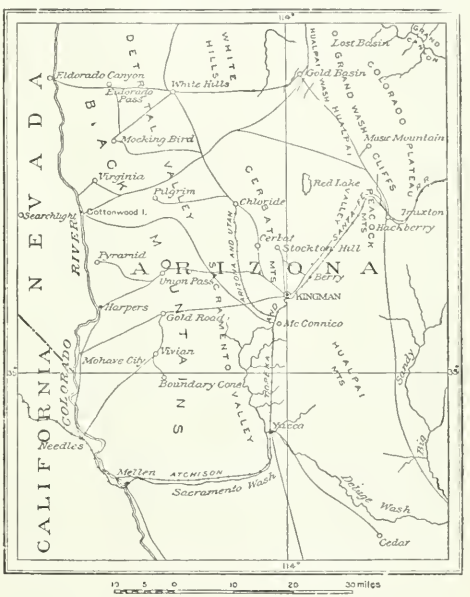
Having had an opportunity to examine but a few properties within the area covered by Mr. Schrader's reconnaissance I shall confine my remarks more particularly to the geological conditions existing in the Gold Road and Vivian districts, within which are situated two well-known properties and about which there is centring a renewed interest because of the encouraging developments on the United Eastern ground.

The entire object of this brief contribution is to help in clearing up, if possible, the rather hazy and somewhat diverse interpretations resulting from Mr. Schrader's none too lucid expression of opinion regarding the geological relationships and the influence on the productive portions of mines within the district of the formation termed by him "green chloritic andesite."

To begin with, the first portion of Mr. Schrader's statement on page 181, "So far as learned, the older andesite as a rule does not contain workable mineral deposits, except along lines where the latite has erupted through it," seems to have been more carefully studied and persistently quoted than the latter part of the sentence in which he clears up the whole situation by writing "except along lines where the latite has erupted through it." This statement is clear enough to anyone who has become thoroughly familiar with the fact that Mr. Schrader uses the terms 'latite' and 'green chloritic andesite' indiscriminately, and explains on page 196 that the green chloritic andesite (or latite) is probably an intrusive into the older andesite, whereas on page 34 he refers to the formation as a flow. This, of course, is rather confusing, and takes some detailed study to interpret his conclusions, especially in view of the following sweeping statement, on page 48: "The most favorable ore horizon seems to be formed by the green chloritic andesite, and in the underlying older andesite the veins are barren."

A study of Mr. Schrader's generalized section across the Black Mountains, on page 35, would lead one to the belief that he considered the green chloritic andesite as being primarily a flow. This may or not be so as regards the formation as a whole. However, in the vicinity of the mines that I examined, in localities rather widely scattered, I found undoubted evidence of the intrusive nature of this formation, and the orebodies are largely formed within the intrusive. Consequently, the maximum thickness Mr. Schrader allows the formation, namely, 800 ft., is not going to be the limiting depth to which the mines within intrusive masses of this material can be worked.

None of this is contrary to certain statements made by Mr. Schrader. However, it takes more than a casual study of his report to arrive at the conclusion that he is not hopelessly contradictory in his statements. It is suggested that if the operators had made a serious study of the report, followed by detailed geological work in the vicinity of the mines in which they were interested, the fear attending the sinking of each succeeding level might have been entirely eliminated and a more extensive development of the deposits, which are so evidently



MAP OF ARIZONA.

within the intrusive masses of the green chloritic andesite, would doubtless have been accomplished ere this. It is to be remarked that in the Gold Road-Vivian districts there are only two properties that have been developed to a depth of over 1000 ft., below which zone both mines are reported to be yielding commercial ore.

To summarize: Many of the veins in this district have been formed within the intrusive phase of the green chloritic andesite or at the contact of rocks which this formation has penetrated. The limiting factor to their productive depth is not going to be the maximum thickness Mr. Schrader ascribes to this formation. I do not intend to imply that all of the veins in this formation will be productive, or if productive, will remain so throughout their course in this formation; simply that the "thickness" of the green chloritic andesite has no apparent connection with the productiveness of the veins.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Wad is an earthy mixture of manganese oxides.

Wrought-iron pipe filled with good concrete makes good mine props. A disadvantage lies in the weight and placing in position.

The first stamp-milling in America was done in Georgia, which borrowed its practice from Hungary. Hungary borrowed from Egypt.

Dynamite freezes at a temperature several degrees higher than that of melting snow. A temperature of 35°F. is low enough to spoil its efficiency.

Antimonial lead commonly contains 15 to 18% of antimony, less than 1% arsenic, and less than 0.5% copper, these being the specifications imposed by the consumers.

Metal that is to be embedded in concrete should be coated with a protective paint to prevent possible damage by electrolysis, otherwise rusting starts, aided by stray electric currents.

Slaking lime produces temperatures up to 400°C., depending on the quality of the lime. At this point it is possible for wood to catch fire during slaking. Lime should not be shipped in contact with wood.

Springing a hole is an operation whereby a few sticks of high-grade dynamite are detonated in the bottom of the hole, producing an enlarged and pear-shaped opening, which can then be filled with explosive powder as required.

A crystal of calc-spar consists of carbonate of lime, it is true, if we only mean that it can be resolved into carbonic acid and quicklime; but if the same carbonic acid is passed over the same quicklime, the result is lime carbonate, but not calc-spar.

Explosion-proof is a term applied by the U. S. Bureau of Mines to motors constructed so as to prevent the ignition of gas surrounding the motor by any sparks, flashes, or explosions of gas or of gas and coal-dust that may occur within the motor-casing.

To face the glare of a furnace or to protect the eyes from excessive light, it is not necessary to use colored spectacles or smoked glass. Protection can be obtained by making a small hole in a sheet of paper or cardboard, when inspecting the furnace.

Forest and city fires create wind. During the fire at Colon, on the Canal Zone, in April, when 19½ acres of buildings was burned, the official meteorologist's records showed a total increase in the wind of from 9 miles when the fire started to a maximum of 15 miles per hour.

Nodulizing of flotation concentrate from copper ores makes pyritic smelting of the nodules possible. The cost of reverberatory smelting has been reduced to such a low figure that the introduction of this extra operation is not usually worth while.

Aluminum, when used to precipitate silver from cyanide solution, requires the addition of caustic soda just prior to precipitation. As aluminum does not even temporarily combine with cyanogen, all the cyanide thus regenerated can be at once determined by the ordinary Liebig titration.

Supposed vanadium oxide, described by Teschemaker, from the Lake Superior region, has proved to consist of Cu_2O upon careful study by W. T. Schaller. It occurs in felted masses of minute prismatic crystals, so thin that under the highest magnification the black border of total reflection covers the entire crystal.

Zinc, as much as 5 or 6% in the slag, gives no trouble in lead smelting if the lead content of the charge is low, but if the lead reaches 30 or 40% of the charge trouble is experienced. Lead smelters in Colorado and Utah average 8 to 15% lead on the charge, but at East Helena, Montana, the lead content is as much as 40%.

Explosion-dust combustion in mines is possible only when the following essential factors are present to participate in its production: (1) flame, (2) combustible dust, and (3) an air-current or draft toward the source of heat, to bring the dust and air in contact with the flame. The fineness and dryness of the dust partly determine its inflammability and ease of ignition.

The most recent improvement in connection with the utilization of blast-furnace gases consists in using the heat contained in the exhaust of the gas-engines for raising steam. In spite of the circulation of cold water in the casing of the cylinder, the exhaust gases emerge at a high temperature, and the heat contained in them may be estimated at 650 calories per horse-power hour.

Belts and ropes for power transmission are decreasing in use as direct motor-driven machinery increases. It seems that the only movement that might seriously affect the future of belts will be the general adoption of the all-electric drive with an individual motor to each machine, but this is hardly within measurable distance of realization, being too expensive an ideal. All experience seems to indicate that the system of the future will be that of grouping machines and machine-tools, the group itself being motor-driven, but the individuals operated by belting. Mistakes often occur in consequence of making the application of particular deductions general; and because individual motor-driving has been adopted with success in certain instances, the inference is not warranted that it is suitable for universal or even for general application.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

DEADWOOD, SOUTH DAKOTA

Maitland District Mines.—Oro Hondo Drill Investigations.—Hidden Treasure.—Wasp No. 2 Profits.—Bismarck Resumes.—Deadwood.—Heidelberg.

Probably the most important item of mining news, and that received with the greatest degree of popular interest, was the announcement that development was to be resumed at the North Homestake property, at Maitland, after a suspension of several years. With that end in view, work of dewatering the shaft was immediately started under the supervision of superintendent Fountain. The workings on the 200-ft. level, from which upward of $1,000,000 of ore was extracted from orebodies lying on the quartzite, have been kept drained ever since work was suspended, and the dewatering only included openings below that point. Here several veins of quartz were encountered in the schists, and although no information was ever made public regarding their value, the present activity is taken to indicate that results were encouraging.

Another property at Maitland that resumed active mining in the past few days was the Echo, where the miners were flooded in the shaft on April 29. At that time the water was removed entirely by bailing, and the flow proving too great to be handled by that method, work was suspended until arrangements could be made to install a sinking-pump, and incidentally to await drier weather, when it might reasonably be expected that less water would be found. In the meanwhile a 10 by 12-in. single-stage compressor, driven by a 30-hp. motor, has been installed. Air from this will be used to operate a No. 5 Cameron sinking-pump. It was also necessary to practically re-build the power transmission-line from the North Homestake transformer-house of the Consolidated Power & Light Co. It was necessary to cut off and re-set nearly all of the poles, owing to rotted butts, and also to place several new poles. Additional copper was also strung to carry the extra power demanded by the new compressor. The shaft will now be pushed to 200 ft., where a station will be cut and an electric station-pump installed. The shaft will probably be continued to 300 ft. before lateral work is commenced.

The Minnesota company, at Maitland, has closed a contract with Burns & Sanford to continue the adit on the Unionville claim. This adit was driven some years ago to prospect the downward continuation of a promising surface outcrop. Paralleling the formation, it reached a point almost vertically under the outcrop, but did not intersect the ore-shoot, which probably is pitching in the direction the adit was driven. This work is being watched with interest, as it may result in the company being able to resume milling.

In sinking the Oro Hondo shaft, which work is in charge of E. W. Talbot, some extremely hard ore has been encountered between the 1500 and 1600-ft. levels. This has caused some delay in sinking. The greatest difficulty was to find steel for the Jackhamers which would stand in good shape; various kinds of bits and makes of steel were tested, with the result that the Crucible Steel Co.'s product was finally adopted. On this steel are forged chisel-bits, similar to the ordinary bit used for drilling by hand; cross-bits and rose-bits of various kinds would not hold up so that a hole cou'd be drilled to the required depth. With the chisel-bit it is possible to get the maximum stock just where it is needed, behind the bit, as well as making the edges of the bit of substantial size, so that the gauge does not wear off too quickly. Mr. Talbot also says that these bits drill faster than any others tried, are cheaper to forge, and easier to handle in nearly every way. On the 1500-ft. level, where the auxiliary-hoist is placed which serves the men who are sinking, cross-cuts are being advanced in both directions from the shaft. In this work water Leyner drills are used. For sinking 'Bull Moose' Jackhamers, the heaviest type of sinker made by the Ingersoll-Rand Co., are used. The machines weigh 105 lb. This exploratory work is being done with the hope of finding the Homestake orebody on its pitch to the southeast. The shaft is half a mile from the Ellison shaft of the Homestake company; its collar is approximately 300 ft. below the collar of the Ellison. The work is being financed by J. T. Milliken, who recently disposed of his Golden Cycle property, at Cripple Creek, for a large consideration.

To secure the services of the best mechanics in the Black Hills, the Hidden Treasure company, operating on Deadwood gulch, had the 50-hp. gasoline engine which drives the hoist and compressor, taken to the Homestake machine-shop, where it was thoroughly overhauled. It has been returned to the Hidden Treasure in excellent condition. From now on it is thought that better progress will be made with the cross-cuts being run on the 200-ft. level, or bottom of the shaft.

With the declaration of a dividend of 1c. per share on June 15, the Wasp No. 2 Mining Co. made its second distribution for the current year. The previous dividend was paid in May. It was at the rate of ½c. per share. During the winter months operations at the Wasp are usually curtailed and sometimes suspended altogether. During the past winter no night shift was employed in the mine; this resulted in reducing the tonnage handled practically 50%, although the yield was more than half of normal, indicating a slightly better grade of ore and a better mill recovery. Since the night shift has again been employed the capacity has been raised nearly to the maximum of 500 tons per day. It is expected that the usual monthly dividends will be paid during the balance of the year.

Arrangements are being perfected for starting the Bismarck mine and mill at full capacity. The property recently reverted to the owner, J. A. Sandholm, of Des Moines, Iowa, the Bismarck Consolidated Mines Co. failing to make the payments on the purchase price specified in the deed and contract. The mill, which was erected by the Bismarck company, and under the contract now belongs to Mr. Sandholm, is one of the best dry-crushing plants in the Black Hills. The mine adjoins the Wasp No. 2, and contains ore practically identical in character with that property; however, it appears to be slightly lower in value. Under the direction of James Hall preliminary steps are being taken. The first work will be the construction of a skipway from the mill to the railway tracks below, over which supplies can be hauled to the mine and mill at a moderate cost. When this is completed other work will be accelerated.

At the annual meeting of the Deadwood-Heidelberg Mining Co., held at Deadwood, the superintendent, A. T. Roos, made an elaborate report covering operations at the mine during the year. Practically all work was in the nature of development, only 48 ft. being driven along the ore, in the course of which 28 tons was removed and shipped to the Golden Reward mill. This lot assayed $16.40 per ton. The shaft was completed to a depth of 193 ft.; it connects with the main adit at 135 ft. Work in the shaft was suspended until machinery could be secured and erected. Exploratory work resulted in finding a second 'vertical' in the shale, parallel with the main vertical and 65 ft. from it. At a point on the opposite side of the gulch

and about 500 ft. distant a vertical was uncovered. Since it is on the strike of the main vertical, it is believed to be a continuation of it. Good assays were gotten. During the year $4080 was realized from the sale of treasury stock. This and the proceeds of the ore shipment was all used to defray operating expenses. The directors have started a campaign to raise $6000 for the present year's operations. Shares are being quite liberally taken by residents of Deadwood and Lead. It is planned to spend the money on the upper ore horizon, to develop the verticals already in sight, and cross-cut in a search for others. No further shaft work will be attempted at the present time.

The value of the gold, silver, and lead produced in South Dakota in 1914 from 30 productive mines, 10 of which were placers, amounted to $7,431,343, compared with $7,424,333 in 1913, as reported by Charles W. Henderson, of the U. S. Geological Survey. The gold output in 1914 was 354,758 oz. fine, valued at $7,333,508, compared with 354,071 oz., valued at $7,319,294, in 1913, an increase of $14,214. The production of silver increased from 172,702 to 176,642 oz. The production of lead was only 3,897 lb. The placer-gold output amounted to only 68 oz. South Dakota has produced in 38 years from 1876 to 1914, inclusive, $185,287,640 gold and 5,832,669 oz. silver, with a commercial value of $4,213,674, a total of $189,501,314. A total of 2,019,262 short tons of ore was mined and treated in 1914, compared with 1,899,167 tons in 1913. Of this total, 2,017,882 tons was treated in the mills in the State, yielding $7,273,702 in gold and 172,574 oz. silver, with an average of $3.605 in gold and 0.086 oz. silver. The output of smelting ore (1380 tons) averaged 2.047 oz. gold and 2.94 oz. of silver to the ton. The Homestake mine and mills were operated continuously throughout the year and yielded 1,587,774 tons, which yielded bullion of the value of $6,160,161, averaging $3.88 per ton, compared with 1,540,961 tons of ore, $6,186,652 in bullion, and an average of $4.01 a ton in 1913.

CRIPPLE CREEK, COLORADO

Trail Development.—U. S. Reduction & Refining Co.—Portland.—Independence.

The Trail mine, on the south side of Bull hill, is one of the most discussed properties in the district at present. The development on the 1200-ft. level, made by Eby & Co. a short time ago, is reported as yielding ore from a vein six feet wide. Settlements so far have averaged about $20 per ton. A night shift was recently put on.

It is reported that on June 19 an adverse decision for R. E. McDonnell and associates was delivered by the Judge of the U. S. District Court in Denver. This affected the suit involving the control of the United States Reduction & Refining Co., of Colorado Springs. Mr. McDonnell was ruled against on every point of his complaint. Arthur Connell, of Colorado Springs, was made permanent receiver of the company. He has power to dispose of all property owned by it. It seems probable that the plant near Colorado Springs will be sold in the near future to the Golden Cycle Mining & Reduction Co. The cash from the sale of property, together with the money in the treasury, will probably go to the bondholders. The Reduction and Refining Co. will then go out of existence.

The air about the district seems charged with excitement, on account of the transfer of the Independence mine and mill to the Portland company. The actual transfer is to take place on July 1. It is generally expected that the new owners will commence an extensive system of mine development. The present leases in the Independence mine will be completed by the first of the month. Most of these lessees and many others have applied to the Portland company for blocks of ground under the régime. The Portland plan will furnish an interesting comparison between the split-check system of leasing and the straight royalty basis, with an added charge for profits above a stated amount. The latter system has been developed by Stratton's, while the former has been in force at the Portland mine.

Renewed activity is apparent at the C. O. D. mine. Three sets of lessees are working, two more are ready, while the new owners of the property have had numerous applications for leases. The main shaft is down over 800 ft. A good ore-shoot has been cut on No. 10 level. A 1500-ft. capacity hoist has been ordered to facilitate development and ore extraction.

Operations of the Cripple Creek Deep Leasing Co. are being followed with interest. At present it is working in the Jerry Johnson mine, which has yielded about $1,750,000 down to 650 ft. Development will be done below this point. The new 100-ton mill and cyanide plant will soon be ready.

GOLDFIELD, NEVADA

Jumbo Extension, New Goldfield Simmerone, and Goldfield Oro Developments.

The Jumbo Extension has continued shipping 100 tons daily, the product averaging $58 per ton. After July 1 the production will be at the rate of 75 tons daily. Ore of shipping grade has been exposed in drifts that have been started from the 526-A raise, the most southerly point at which the ore-channel has been penetrated. This further established the trend of the ore to the south, toward the St. Ives claim of the Merger Co. From the dip of the shale, it is apparent that the south drift following the fissure within the shale will reach the contact of shale and latite near the southern boundary line of the Paloverde claim. Raise 524-A, driven from a point near the centre of the rich 524 drift, has advanced in good ore, on the dip of the shale, for over 100 ft., and a drift to the east on the contact has exposed ore from 2 to 3 ft. wide, assaying over $200 per ton.

An interesting discovery has been made in ground belonging to the New Goldfield Simmerone company, within 2½ ft. of the old incline shaft from which early operations produced exceedingly rich ore. Superintendent Knickerbocker shot into the supposed foot-wall, 5 ft. below the surface, and exposed 18 in. of ore panning freely and estimated to assay $50 to $100 per ton. Good pannings are also being obtained on the 100-ft. level, and work on the 250-ft. level is nearing the same point of intersection of two lodes.

On the 800-ft. level of the Goldfield Oro a new water-channel has just been opened, where the appearance of the quartz is said to be encouraging. The Sandstone-Kendall Consolidated is making good progress in sinking its winze from the 500 ft. level, following the vein, and will shortly cross-cut to the hanging wall. On the 500-ft. level of the Booth, the foot-wall drift continues in low-grade free-milling ore that should ultimately be handled at a profit. Raises in the Kewanas are following seams of $10 ore from the shale-contact drifts at a depth of 840 ft. The Great Bend main-shaft is being unwatered rapidly and the old platform at the 300-ft. level, upon which a large quantity of refuse had accumulated, has now been removed.

The final report of the Goldfield Consolidated for May shows that 32,280 tons of ore yielded $161,653 net. All expenses were $5.27 per ton. Development totaled 3194 ft., at $6.56 per foot. Lessees extracted 1148 tons worth $132,283. Of this the company received $66,256, less transportation and treatment charges.

Up to June 26 the Florence had shipped 350 tons of ore for the month. The stope recently started on a new vein at 250 ft. in the old Florence Consolidated lease continues to give good results. A raise north of the stope shows 4 ft. of $20 ore.

On July 19 the Jumbo Extension company will hold its annual meeting at Phoenix, Arizona. The report for the year will soon be distributed.

A drilling contest will take place at Goldfield on July 4. A large number of miners will compete.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

Fairbanks

In the *Fairbanks Weekly Times* of May 24 was a symposium on what it terms 'The Quartz Question' of the district. 'Optimist' argued that it was already a rich quartz camp, with a good future. Placer mining will pass out in three years. 'Pessimist' thought that Fairbanks would not make a quartz camp, the experience of nine years' work. 'Impartial Observer' considers the centre has excellent quartz prospects. It has not had a proper test. Better roads and milling facilities would stimulate quartz mining. The various properties are briefly described, showing the work under way at the Rhoads Hall, Teddy R., Crites and Feldman, Tyndall and Finn, Stevens, Mizpah, and others. A Lane mill from Los Angeles is to be installed on Fairbanks creek by C. E. Heilig. It will work with a Huntington mill.

Fairbanks business men returned from a study of the Tolovana district on May 23. They were confident that the district would turn out to be fairly good. A large number of men are busy on the creeks.

It is reported that crops of interior Alaska, especially in the Tanana valley, will be larger than ever. Potatoes look extremely well.

Juneau

The Alaska Gastineau company has 180 men employed at the Annex power scheme. A 1350-ft. tunnel is to be driven to tap Annex lake 100 ft. below water-level. An incline tramway 3000 ft. long has been completed, rising 700 ft. above the beach. The top end connects with a railway 4000 ft. long going to the tunnel mentioned.

May gold returns of the mines on Douglas island were as follows:

Details of operation	Mexican	Treadwell	United
Development, feet	359	767	1360
Lowest level, feet	1,750	2,100	2,200
Broken ore stock, tons	–16,164	–47,815	–19,878
Stamps dropping	120	540	270
Ore crushed, tons	19,320	79,832	46,179
Gold by amalgamation	$16,086	$85,676	$47,421
Gold from concentrate	13,966	83,198	48,021
Concentrate, tons	451	1,700	1,046
Average per ton ore	$1.56	$2.12	$2.04
Profit	$6,258	$77,192	$22,133

On June 19 the crank-shaft of the great hoist at the Central shaft of the Treadwell mines broke. The break occurred between the drum and disc on the left side. The shaft is 10 ft. long, 19 in. diameter, weighing 26 tons. About a month will be required to make and install a new one, it probably coming from Bethlehem, Pennsylvania. As a result of this accident the '300,' '240,' and Mexican mills are closed, and the '700' is at less than half capacity. The Treadwell and Mexican hoists are being overhauled for work.

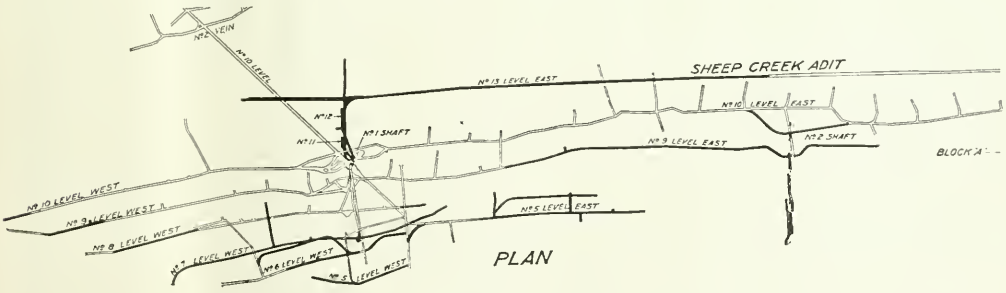
ARIZONA

Gila County

Last week the Old Dominion company disbursed bonuses to salaried employees. Starting at $150 per month the bonus was $10, $15 for $200, and $20 for over $200.

Mohave County

The vein cut at 565 ft. in the United Eastern is proving to be of considerable extent. It is 37 ft. wide, 22 ft. of which assays $36.60 per ton. Gold is visible in parts of it.——At 300 ft. in the Pittsburg the west drift is in formation similar to the United Eastern.——Extensive development is to continue at the Black Range, in charge of D. P. Wright.——A hoist, engine and compressor, and other equipment for sinking from 155 to 300 ft. is to be installed.——Kingman people are interested in the Carter mine which is opening well at 150 ft. The shaft is to be sunk to 300 ft.——The Telluride is a promising property. Cross-cutting is underway at 400 ft. depth.



PERSEVERANCE MINE, JUNEAU.

Santa Cruz County

The development company that was working at the World's Fair mine at Harshaw has turned it over to the owner, Frank Powers. Under his management sinking and driving continues.

Yavapai County

In the *Yavapai* for June the Chamber of Commerce at Prescott publishes a list of mining properties desiring capital to assist in their development. The Chamber does not know the merits of these mines. On some of them a good deal of work has been done, and equipment erected.

ARKANSAS

Mining men in this state have formed the Zinc Ore Producers' Association of Arkansas. E. Zimmerman is president.

and G. W. Chase is secretary at Yellville. The idea of the organization is to protect producers in the sale of their ore.

CALIFORNIA

In connection with Assembly Bill No. 487, known as the 'semi-monthly pay-day bill,' the attorney-general, U. S. Webb, states that if the wages earned prior to the 16th day of the month are paid on the last day of the month, they clearly come within the terms of the statute; and if the wages earned subsequent to the 15th day of the month, and prior to the 1st day of the following month are paid on the last day of the month in which they are earned, they are paid 15 days before the statute requires them to be paid.

Oil production statistics in May are as follows: rigs completed, 14; wells drilling, 138; completed, 41; abandoned, 38; producing, 5943; and yield, 7,686,517 bbl., according to the Independent Oil Producers' Agency. There was no surplus, stocks, 60,820,315 bbl. at the end of the month, being drawn on by 74,075 bbl. Figures compiled by the Standard Oil Co. vary slightly from the above. They indicate an output of 7,630,743 bbl., and a surplus of 5294 bbl. Well details also show a difference.

Butte County

The El Oro Dredging Co. has finished dredging its area at Oroville. The last boat is being dismantled. From 1904 to 1913 No. 1 boat dug 5,015,416 cu. yd. of gravel, and from 1908 to May 1915, No. 2 moved 3,789,819 cu. yd., a total of $8,805,235 yards.

Inyo County

A 21-page report with plan and illustrations has been issued by the Reward Gold Mines Co., operating in the Russ district, east of Mt. Whitney. The company is incorporated in Arizona with 1,000,000 shares at $1 each. The area is 180 acres. The mine is opened on five different levels. Approximately $270,337 in gold ore is blocked out. Reports on this ore were made by W. H. Landers, A. Burnett, and F. N. Fletcher. They estimated the gross value of positive ore at $317,046, $228,048, and $265,917 respectively. An average of the three estimates gives $270,337. The ore varies from $11.79 to $13.70 per ton. The total cost of operations is estimated at $6 per ton. The equipment and buildings, including a 20-stamp mill and concentrating plant, compressor, motors, houses, etc., originally cost $100,000. Recovery has been low, and a cyanide plant is necessary. Tests show that 90% can be recovered.

Nevada County

Considerable interest was shown in Grass Valley on June 23, when the crank shaft for the new hoist at the North Star central shaft was hauled to the mine. Twenty-four horses pulled the 23 tons of machinery, aided at one point by an electric street car.

Shasta County

Three furnaces are in blast at the Kennett smelter of the Mammoth company. A fourth is to be blown-in. Over 700 men are employed at the mine and plant. At the California mineral exhibit in the Palace of Mines at the Exposition, the Mammoth company displays ores, matte, blister copper, photographs of its works, and an excellent glass model of the mine.

It is reported that the Balaklala Copper Co.'s smelter at Coram will resume work at an early date. A court injunction closed it in July 1911. It has since been re-modeled to lessen the fume.

COLORADO

Lake County (Leadville)

The Valley adit at Prospect mountain, mentioned in the Press last week, is in 1150 ft. This work is of considerable importance.——Lessees at the Lalla Rookh and Forest City in Big Evans gulch are opening a wide vein.——A new hoist and other equipment are to be installed at the Fortune, which is to work through the Yak tunnel.——Lessees at the Humboldt and other properties are getting good results.

Mineral County

(Special Correspondence.)—It is reported that the Bachelor company at Creede is contemplating the erection of a mill to treat its low-grade ore by the chloridizing process now being successfully used in Park City, Utah. The idea is to build a mill below Creede. The ore will be brought through the Commodore No. 4 tunnel, then over the Commodore tram and to the mill in railroad cars over the D. & R. G. tracks. The Bachelor has not shipped anything for some time.

It is rumored that a plan for several of the companies to get together and pump out the ground below the Wooster tunnel, which drains the principal mines of the district is about to be consumated. They have tried to do something of this sort before, but nothing resulted.

The Creede United Mines Co. is now running the Humphreys concentrator on ore from its properties, the Happy Thought, Park Regent, etc., and is shipping lead and zinc concentrate, as well as some crude lead ore that is sorted out at the head of the mill.

The Del Monte-Chance is shipping about 4000 tons per month. ——The Commodore is being worked in a small way by lessees who make small shipments from time to time.——The Equity, which is at the head of West Willow creek, seven or eight miles from Creede, is developing a good body of ore in an east and west vein. It is handicapped by being so far away from the town and railroad.——The other mines of the district are shut down and the place is pretty quiet.

The fluorspar mine at Wagon Wheel Gap is still shut down, but may be re-opened this summer. The only market for its product, which is said to be of remarkably good quality, is the C. F. & I. steel-works at Pueblo, which has not been doing a great deal lately.

Creede, June 20.

San Miguel County

(Special Correspondence.)—Bulkeley Wells, manager of the Smuggler-Union mines, at Telluride, and associates have taken over the Humboldt, Sailor's Fortune, and Tom Payne claims, on the northerly extension of the Smuggler-Union vein on the Ouray side of the range, besides other claims in the immediate neighborhood. John B. Farish controlled the Humboldt properties for a long period, and the last operations consisted of considerable development work, for which it is understood that Pat Calhoun of San Francisco provided the money. A connection with the Smuggler-Union workings on the Marshall Basin side of the range can conveniently be made by extending the old Sheridan adit a short distance to the Humboldt workings. It is understood that arrangements will be made to treat the Humboldt ore in the Smuggler-Union company's mill at Pandora. The value of the Humboldt ore is mainly in silver, and the vein is generally quite narrow, as now exposed in the workings. In Purington's report on the Telluride Quadrangle, the Humboldt workings in their relation to those of the Smuggler-Union are shown about 200 ft. too low. H. C. Lay's name is attached to the section, but he disclaimed responsibility for the error.

Telluride, June 23.

IDAHO

Blaine County

Forty-eight tons of lead-silver concentrate from the Wilbert mine, Dome district, netted $2957. The product assayed 6.55 oz. silver and 56.65% lead. The output from now on will be 600 tons per month.

Bonner County

Caterpillar tractors with 10-ton capacity trailers have proved successful in hauling ore from the Idaho-Continental mine to Porthill on the railroad, a distance of 26 miles. Three more engines are to be ordered. Regular shipments of ore are to be made to Salt Lake City. The mine is well opened for production.

Shoshone County (Coeur d'Alene)

As a result of the high price of zinc the Interstate-Callahan made a profit of $175,000 during the week ended June 12. The weekly output is 1400 tons of concentrate assaying 50% zinc, and 100 tons of 50% lead. A special dividend is likely for August, when the quarterly amount is due.

Negotiations on the smelting contract between the Hercules company and the A. S. & R. Co. were held at Spokane on June 22, and at Wallace on the next day. Nothing was agreed upon.

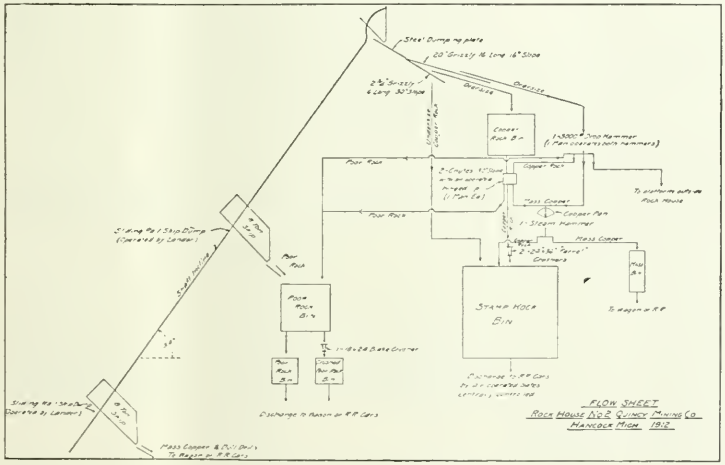
On June 23, H. F. Samuels, president and general manager of the Success Mining Co., sold his $1,100,000 shares (total capital 1,500,000 shares) to Duluth people for about $1 per share, cash. J. F. Howarth and P. J. Gearon of Wallace negotiated the transaction. The mine is at Nine Mile, near the Interstate-Callahan. A 200-ton mill is treating lead-zinc ore. Dividends are being paid, the total being $1,050,000. On June 23 the cash balance was $136,826. There is also on hand 800 tons of zinc concentrate worth $100,000.

MICHIGAN

The Copper Country

The White Pine Extension Copper Co. has been formed by Detroit people headed by S. L. Smith, with a capital of 150,000 shares. The mine is said to be opened by 6000 ft. of workings, proving the lode extension from the White Pine, which is now producing copper. Drilling in the Extension has given very uniform results.

Drilling at Cliff has been resumed by the Calumet & Hecla. Rich amygdaloid formation has been opened at 900 ft. in the New Arcadian.



Flow-sheet, Quincy No. 2 ore-house.

MISSOURI

Jasper County

On June 24 three new mining laws became effective in this state. One provides that every mine employing 10 or more men must have water handy for laying dust. The other two enforce sanitary drinking devices and sanitary change-houses.

From the top price of $135 per ton paid for 60% zinc concentrate in the previous week, the price last week varied from $128 to $90, the widest range on record. Calamine was quoted at $55 to $65 per ton. Lead was unchanged, $72, basis of 80% metal. The averages were $110.32, $61.69, and $71.61 respectively. The output was 9,831,360 lb. blende, 1,003,120 lb. calamine, and 1,290,240 lb. lead, having a total value of $629,355. Last week the value was $1,048,349.

The O. L. F. mine at Duenweg, offered for sale six months ago for $8000, was disposed of last week for $125,000. A 250-ton mill is included. Some rich zinc ore has been opened.

The two men who were entombed in the Longacre-Chapman mine two weeks ago, with others who were rescued, have been found dead.

MONTANA

Jefferson County

(Special Correspondence.)—Arrangements have been made whereby the Comet mill will be started on tailing that has lain there for over 20 years. Sampling and testing has been done. It is probable that a flotation process will be used. This is working at the old mill at Basin.

Little is being done at Elkhorn since the Longmaid interests suspended work on the old Elkhorn silver mine. The district offers a choice of ores to suit all miners. Though no small amount of attention has been given the place by engineers during the past two or three years, financial conditions have been against completion of the several transactions under consideration.

Boulder, June 10.

Lewis and Clark County

The Helena mining region is more active than for years. Work of the Helena Mining Bureau is greatly responsible for this. The Bureau has spent $10,319 in 13 months in its promotion work. On June 1 it had a balance of $2928. As nearly as can be ascertained the number of men employed in Marysville, Bald Butte, Scratch Gravel, Helena, Unionville, Rimini, Wickes-Corbin, Lump gulch, Clancy, Winston, York, and other districts aggregates 700, and is on the increase.

A new furnace of 275-ton capacity has been blown-in at the East Helena smelter. Seventy-five additional men are employed. A fourth furnace may be started in August. Three furnaces are now treating 750 tons per day.

Silverbow County

Illinois people have decided to invest $50,000 to $75,000 in the Butte and Great Falls mine in Dixie gulch. The shaft is down 350 ft. Water at 300 ft. forced the suspension of work. This level is to be unwatered, the shaft deepened, and a hoist and compressor, etc., installed. B. Green is in charge.

At the Butte-Ballaklava 90 men are employed. The output is up to 200 tons per day, going to the Washoe smelter.

Yellowstone County

About 15 teams from Montana mines will compete at the first-aid contests to be held at Billings on July 23 and 24.

NEVADA

Humboldt County

The Friedman adit, being driven in Nenzel hill at Rochester to cut the veins at a depth of 1200 ft., is in 750 ft.——At the La Tosca mine, six miles from Rochester, the Humboldt Consolidated has its adit in 2000 ft. This is expected to cut the veins at 1000 ft. depth. Important developments will probably occur shortly.

Lincoln County

On July 6 the 100-hp. electric plant at the Prince Consolidated at Pioche will be started. The winze below the 550-ft.

level is down 100 ft. High-grade shoots were cut. Ore extraction and loading ore on trains at Pioche costs $1.21 per ton.

Mineral County

The Nevada-Regent Mines Co., backed by Jesse Knight and others of Utah and Nevada, has been formed with a capital of $100,000. The company has secured 18 claims in the Regent district, now worked by lessees. A shaft is down 100 ft. on a vein 18-in. wide at the surface. At 60 ft. it is 15 ft. wide, averaging $25 per ton in silver. The lessees have stoped 1000 tons above 60 ft., and expect 4000 from there to 100 ft. The company will sink a shaft to cut the vein on its dip at 250 ft. vertical.

A correspondent in the *Western Nevada Miner*, of Mina, states that well known engineers have been examining the Rand district. Three properties have already shipped ore worth $60,000. Estimates place the reserves in the mines at $100,000, and several thousand tons on dumps. Down to 250 ft. the Last Hope has produced $30,000. The Golden Pen is down 200 ft. The last car of ore assayed $600 per ton. Prospects are excellent. Tonopah people are negotiating for this mine. The Queen Regent is in the centre of the district. A wide vein has been cut at 70 ft. depth. A hoist has been erected, and sinking will continue to 500 ft. This and the Last Hope company contemplate erecting a mill. The Mims claims have been acquired by J. E. Kerr of San Francisco.

Nye County

Last week's output of companies and lessees at Tonopah totaled 10,642 tons worth $217,570.——The Belmont shipped bullion and concentrate valued at $145,000.——On July 21 the Tonopah company will pay $250,000.——In May the Extension made a profit of $43,223.——The Tonopah East End Development Co. has issued a report for the year ended May 31, 1915. The shaft is down 440 ft. Water lately has flowed up to 30,000 gal. per day. Motor-driven pumps have been ordered. Cash amounted to $250. To continue operations the company will sell 300,000 shares.

On June 24 hydraulicking started at the Round Mountain company's deposit at Round Mountain. It took 2 hours 50 minutes for the water to fill the 8 miles of pipe. The line is holding well. There were no leaks.

At Volcano last week, miners in a shaft at the McCarthy and Mooney lease broke into a fissure at 55 ft. It is from 18 in. to 12 or 14 ft. wide, while its depth is unknown yet. The shaft is in porphyry and andesite. The walls of the cave are carbonate of lime.

The new 200-ton mill at the Monitor-Belmont at Belmont, 50 miles north of Tonopah, will be complete early in August. It is being erected next to a dump of 50,000 tons of 16 to 18-oz. silver ore. The plant includes ten 1600-lb. stamps and a 6 by 10-ft. tube-mill. Concentration will be done by flotation. Norman E. Smith is superintendent. Three shafts are down 600, 750, and 1100 ft. respectively; also two adits 1000 ft. each. The formation is mainly slate-granite contact. The ore is quartz.

Storey County

According to Charles Butters, the plant at Six-Mile canyon is to be re-started in charge of C. Morris. The tailing near the mill is to be treated.

A dredge is to be erected by H. E. Ray of Dayton on ground between Dayton and Virginia City. A large yardage of rich gravel is said to be available.

UTAH

Juab County

Shipments from Tintic last week totaled 185 cars of ore.

The formation of a company to treat custom ore at Tintic has been mentioned in this journal. The Tintic Milling Co. has been organized with a capital of $30,000. It will purchase the assets of the Knight-Christensen Metallurgical Co. at Silver City and the Mines Operating Co. at Park City, and construct a chlorination plant at the site of the old Knight smelter at Silver City. The officers of the Tintic Milling Co. are Jesse Knight, president; George H. Dern, vice-president and general manager; W. Lester Mangum, secretary and treasurer, and Theodore P. Holt, general superintendent. Besides taking over what is left of the Knight-Christensen plant which was burned several months ago, the new concern also takes over the contracts that the company has for treating ores of the Knight mines, including the Beck Tunnel, Colorado, Black Jack, Iron Blossom, Salvadore, and Dragon Consolidated. The Knight interests will own practically 51% of the new company and George H. Dern 49%, although the management will be retained by the later. The construction of the plant has already started and it will begin operations with a capacity of 300 tons of low-grade ore a day. This will probably be increased later. The Mines Operating plant will be dismantled at once and moved to Tintic.

Electric power is gradually displacing steam in this district, especially for hoists. The Utah Power Co. supplies the current.

Summit County

The Silver King Consolidated is shipping 100 tons of ore daily. It averages 50.4 oz. silver, 0.0514 oz. gold, 28% lead, and 1.291% copper. Development, especially at 1700 ft., continues very satisfactory.

The Ontario Silver Mining Co. has issued a statement for 1914. Little was done during the year. Work was resumed in May of 1915. The present output of ore is about 600 tons per month. Some of it is high in silver, up to 100 oz. per ton, and 9 to 10% lead. The revenue was $33,712. Cash and investments total $323,379. Ernest Bamberger is general manager.

Utah County

Machinery, rails, cars, lumber, etc., has been hauled to the Pittsburg Mining Co.'s mine at the head of American Fork canyon. A good deal of zinc and lead-silver ore has been opened.

WASHINGTON

Ferry County

In the intermediate and lower level of the Knob Hill mine at Republic, 4 and 7 ft. of $20 and $50 ore respectively has been opened. A year ago 11 cars of ore from near this point were worth $55,000. The weekly output at present is two cars, returning $2100 per car. Sixteen men are employed. The company has paid off its debt, and is building up a surplus.

Stevens County

The first unit of the new stamp-mill at the United Copper mine in the Chewelah district, 60 miles north of Spokane, was started last week. It is treating 150 tons of ore per day and producing about 10 tons of high-grade concentrate, according to Conrad Wolfe, the manager. The mill is giving satisfactory results. Work is progressing well toward the completion of the additional unit, which will bring the capacity up to 350 tons per day. About 125 tons of crude ore and 25 tons of tailing is handled every day. A station is being cut at the 1000-ft. level in the shaft. Hoist equipment will be installed of sufficient capacity to sink the shaft another 1000 ft. making a depth of 2000 ft. Sinking will continue as soon as the power company is able to deliver additional power from its plant at Meyers Falls. This will be about September 1.

VIRGINIA

Norfolk County

(Special Correspondence.)—The Virginia Smelting Co., which operates a plant at West Norfolk, Virginia, is making a number of alterations. Under guidance of Utley Wedge, a chloridizing plant is being built for treatment of Eustis fine cinder and other pyrite cinder that has been sintered. The product from the Wedge 5-hearth Rameu Beskow furnaces

will then go to leaching vats for treatment by the McKay process. Mr. Wedge is also building a plant for the commercial production of SO_2 consisting of hot-wells, scrubbers, lime-towers, and heat-exchange units. This will wash all gases coming from blast-furnaces and converters, and is expected to produce a product of some value. E. C. Vigeron has gone there as manager.

West Norfolk, June 20.

CANADA

Alberta

(Special Correspondence.)—The Southern Alberta Oil Co. has encountered oil in large quantities at a depth of 3527 ft., two miles north of the Dingman well near Calgary. The company will put down a second well in the same neighborhood.

Calgary, June 20.

Ontario

(Special Correspondence.)—The contracts between the Timiskaming and Beaver companies and the Northern Ontario Light, Heat & Power Co. for supply of electric power expired on June 1. The power company submitted new rates, increasing the price about 50%. The companies have refused to accept these terms and the question is in dispute.——The Timiskaming & Hudson Bay company has let a contract to David Craig for 600 ft. of driving at the 238 and 330 ft. levels on its property south of the McKinley-Darragh. The drift will be in the conglomerate along the Cobalt Lake fault.

At the Lake Shore mine, Kirkland Lake, the vein has been found to be very rich at the contact between porphyry and conglomerate, but the grade is not maintained elsewhere.

Development at the Gibson claim on Goodfish lake, near Kirkland Lake, at 80 ft. shows two distinct veins. One is about 24 in. and the other 12 in. wide, showing some visible gold. The property is under option to a New York syndicate, with whom Frank Loring, now in charge, is associated.

Cobalt, June 20.

In May the Dome mine produced 26,000 tons averaging $4.28 per ton.

On July 15 the Crown Reserve will distribute $53,064, making $6,102,363 to date.

MEXICO

It is reported that the American Smelting & Refining Co. will blow-in its smelters at Monterey and Matehuala. At Chihuahua there are four furnaces in blast. The Aguascalientes plant is still shut down.

Sonora

For some time the Moctezuma Copper Co. at Nacozari, has sold food and supplies to small properties in the district. On account of the railway to Douglas being stopped, the company finds it cannot sell any more material. Regions south of Nacozari are very short of common necessities.

PHILIPPINE ISLANDS

During April the Philippine Dredges, Ltd., had the following output:

Boat.	Cubic yards.	Average per yard, cents.
No. 1	37,850	22
No. 2	48,897	26
No. 3	58,569	18
No. 4	60,000	12

The total gold recovered was 1868 oz., a record.

The Utah section of the A. I. M. E. will have an excursion to the Tintic district on July 15. Several mines will be visited. Papers to be read are from G. W. Crane, 'Geology of Ore Deposits and Geological Methods Applied to Mining in the Tintic District, Utah,' and D. A. Lyon, 'The Zinc Problem in the Treatment of Low-Grade Zinc and Zinc-Lead Ores.'

PERSONAL

J. D. Hubbard has returned from Butte county.

H. W. McFarren is here from Santa Fé, New Mexico.

W. J. Loring has returned to San Francisco from New York.

C. W. Purington is returning to the Lena goldfield, Siberia.

J. S. Diller was in San Francisco and has gone to Mt. Lassen.

R. W. Pringle is consulting engineer to the Central Rhodesia company.

W. S. Hopper was in San Francisco and has gone to British Columbia.

A. Chester Beatty has moved his office to 25 Broad St., New York.

G. H. Garrey was here from New York, on his way to Tuolumne county.

Fred C. Alsdorf is in New York, but expects to leave for Los Angeles shortly.

E. C. Vigeon is now manager for the Virginia Smelting Co., at West Norfolk.

W. H. Dawe has been elected president of the Transvaal Chamber of Mines.

B. B. Gottsberger, general manager for the Miami Copper Co., is on a fishing holiday in California.

Charles F. Willis has been appointed director of the Arizona State Bureau of Mines.

R. Gilman Brown, Deane P. Mitchell, and Leslie Urquhart were delayed in going to Siberia, but are starting now.

E. F. Burchard has been selected as geologist in charge of non-metals section of the division of Mineral Recources, U. S. Geological Survey.

W. L. Honnold has resigned his connection with the Brakpan and Springs mines, at Johannesburg, and is returning to the United States.

Edgar Newhouse, C. W. Whitley, H. A. Prosser, W. H. Howard, Willard S. Morse, Roger Strauss, and William Loeb of the A. S. & R. company are here on a tour of inspection.

Schools and Societies

The Michigan College of Mines *Theta Tau* fraternity, an engineering association, principally mining, will hold a convention, the third biennial, at the University of California on September 8 to 11.

The American Mining Congress announces from its offices in Washington that its next convention, which will be the eighteenth, will be held at San Francisco on September 20, 21, and 22, the meeting immediately preceding that of the American Mine Safety Association which will take place on September 23 and 24, and following the International Engineering Congress on September 20. The chief topics of discussion of the Mining Congress will relate to the Western public-land problems and legislation, now so conspicuous in the legislation of the National Congress at Washington.

The School of Mines of Western Australia, at Kalgoorlie, under the Government Department of Mines, has issued its syllabus for 1915, and annual report for the year ended December 31, 1914. The publication covers 105 pages and is well illustrated with pictures of the institution. The staff consists of nine instructors and five laboratory assistants. The attendance in the three terms of 1914 was 594, 514, and 403, respectively. Thirty-nine, seventy-one, and eighty-eight students passed respectively the first, second, and third classes in 22 subjects at the examinations in November. The school is excellently equipped for all practical instruction. Good prizes and scholarships are offered.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, July 1.

Antimony	35 —35⅝
Electrolytic copper	20½—20¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$85
Spelter	22 —22¼
Tin	41 —42½
Zinc-dust, 100-kg. zinc-lined cases	30

Supplies of zinc-dust are small.

EASTERN METAL MARKET
(By wire from New York.)

NEW YORK, July 1.—Copper is quiet, the quotation is nearly nominal; re-sale lots of lead are disappearing; the demand for spelter seems likely to increase.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
June 24	48.75	May 19	49.93
" 25	48.50	" 26	49.77
" 26	48.62	June 2	49.40
" 27 Sunday		" 9	49.35
" 28	48.50	" 16	49.31
" 29	48.00	" 23	48.97
" 30	48.00	" 30	48.40

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The weakness in silver continues. On June 26 about 410,000 oz. left San Francisco for China. On June 22 the Nipissing company dispatched 250,797 oz. to New York. To this date of 1915 this mine has sent 3,137,942 oz., valued at $1,554,155 to London. Some went direct, the remainder by way of New York.

Writing on June 10, Samuel Montagu & Co. say that selling on China accounts for depressed prices. Not much weight is attached to advancing prices, when they are the outcome of a shrinkage in supplies. It has been rare for any silver to be offered for sale in the afternoon, and when the market is small, the close of each day is likely to be accompanied with a hardening tendency. Inquiry has arisen from the Indian Bazaars, but not of an extensive character. The Continental demand has also been slight. Buying at the present time is not hearty enough to insure an impression of confidence whenever supplies become normal as to quantity.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
June 24	18.50	May 19	15.08
" 25	20.00	" 26	17 79
" 26	20.50	June 2	22.10
" 27 Sunday		" 9	26.17
" 28	21.00	" 16	22 83
" 29	21.50	" 23	18.71
" 30	22.00	" 30	20.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9 78	Oct.	4.75	....
May	4.91	17.03	Nov.	5 01	....
June	4.84	22.26	Dec.	5.40	....

On July 7 the New Jersey Zinc Co. meets to increase its capital from $10,000,000 to $35,000,000.

Twenty-seven tons of 63.5% zinc concentrate sold at Joplin three weeks ago has been settled for at $139.90 per ton, the highest ever paid in the region.

A London metal house, writing under date of June 11, says: "The event of the week has been the announcement by the Munitions Committee that it contemplates issuing instructions to commandeer all spelter other than that being used for cartridge making, and to prohibit its use for galvanized sheets and work other than for war purposes. This official announcement caused some perturbation on 'change among dealers, who naturally wondered how they stood with regard to existing contracts. A little later, however, it was announced that business was to be carried on as usual in the metal, and it seems to us, therefore, that all contracts made will stand for the present."

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 24	20.00	May 19	18.68
" 25	20.00	" 26	18.50
" 26	20.00	June 2	18.67
" 27 Sunday		" 9	19.39
" 28	20.00	" 16	20.12
" 29	20.00	" 23	20.00
" 30	20.00	" 30	20.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended June 12 totaled 11,064,237 lb., valued at $2,068,756. Of this, France took 7,121,938 lb.; England, 2,809,347 lb., Italy, 743,187 lb., and Russia, in Asia, 224,174 lb. Imports of all kinds of copper amounted to 3,252,341 lb., worth $382,214.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	38.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On June 30 tin was quoted at 39.50 to 41 cents.

England has placed an embargo on the exportation of tinplate to Denmark, Norway, Holland, and Sweden. The purpose is to shut off any outside supply to Germany. On receipt of the news in New York on June 25, the tin market was strengthened ½c. Important consumers of tin made inquiry for both spot and future shipments of tin.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
June 24	5.50	May 19	4.20
" 25	5.50	" 26	4 29
" 26	5.50	June 2	4 69
" 27 Sunday		" 9	5.44
" 28	5.50	" 16	6.66
" 29	5.60	" 23	5.82
" 30	5.70	" 30	5.55

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4 02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June 2	80.00	June 16	90.00
" 9	90.00	" 23	95 00
		" 30	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39 00	78.00	Sept.	76.25	....
Apr	38.90	77.50	Oct.	53 00	....
May	39 00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

ALUMINUM

The market is strong at 31 to 32c. per pound.

Eastern Metal Market

New York, June 25.

A quiet week has brought about easier prices in nearly all the metals. In copper and spelter the situation may change radically at any moment. Despite concessions by others the larger copper producers are firmly holding to 20.50c., 30 days, delivered, for electrolytic. The feeling is that the War demand will be renewed in force in the near future. After dropping to 18c., spelter has steadied, and gained a little strength from export demand. Zinc exports are shown, by Government figures, to have increased heavily. The U. S. Steel Corporation has contracted for a year's supply of Australian zinc ore for its new plant to be built at Donora, Pennsylvania. Lead has declined, until offerings of 5.45c. or less, have been made, although the A. S. & R. Co. continues to quote 5.75c. Consumers who bought beyond their needs on the rise and later attempted to sell have been disappointed. Tin has been quiet. Antimony continues strong and sales are reported. Aluminum is a little higher.

The War demand continues the dominating feature of business in the East. For some classes of metal-working machinery, such as turret-lathes, automatic screw-machines and engine-lathes, orders representing hundreds of thousands of dollars have been declined by the manufacturers, who are so loaded up with orders that they cannot make the deliveries desired. Machinery for rolling brass is being ordered from England.

COPPER

The market has been quiet and a little weakness has developed in prices as quoted by one or two smaller producers and by second-hands. The larger producers have held to 20.50c., 30 days, delivered, or 20.37½c. cash, New York, on the theory that the requirements of manufacturers of war munitions are not yet satisfied. As a matter of fact, good-sized inquiries have come out in the week which have not yet been consumated by sales. Throughout the week copper could be had at 20c., although any considerable buying would have quickly sent prices up. Prime grades of Lake are quoted at 22.50 to 23.50c., although brands suitable for many purposes can be had at 20 to 20.50c. Not only the attitude of the producers, but the general conditions indicate that the market is healthy. Exports up to June 25 totaled 13,890 tons.

SPELTER

Dullness without interruption and a steady decline was the case with spelter for some days. The quotation reached 18c., June 22. It has since hovered there, indicating a growing steadiness. The situation was helped along by a moderate amount of export buying. The decline referred to was entirely in prime Western, the higher grades, or brass-mill special, holding their own in a nominal market. Justification for a strong market appears in the figures showing the April exports and those of the 10 months ended April, as issued by the Bureau of Foreign and Domestic Commerce. In April the exports of domestic spelter in pigs, bars, plates and shapes amounted to 17,683,173 lb. against 120,149 lb. in April, 1914. In the 10 months ended April 1915, the exports totaled 222,478,162 lb., compared with 3,243,418 lb. in the same period of 1914, and 4,997,680 lb. in 1913. It will be noticed that the 10 months ended April, 1915, go back one month prior to the War. These figures are taken as a 'bull' influence, but the trade does not so construe the suggestion of the Munition Commission of England that it might prohibit the use of spelter for galvanizing in that country. The idea, of course, is to conserve the supply for war needs. The exports of spelter of foreign origin in April totaled 153,561 lb., bringing the total for 10 months to 17,451,565 lb. The exports from June 1 to 25 totaled 1569 long tons.

The plan of the U. S. Steel Corporation to build a smelter at Donora, near Pittsburg, is pronounced a wise one. Some point to the possibility of the corporation selling some of its product to outsiders. Again, it is said that by the time the Corporation has the smelter in operation it may find that it can buy spelter cheaper in the open market. The entire matter is one of conjecture. The Corporation brings tin from the Far East in its own ships, and is largely independent of the domestic tin market, and probably desires to be equally as free in the matter of zinc. Since the outbreak of the War a number of small smelting companies are reported to have been formed, but it is a question how they will fare after the present abnormal conditions pass. The initial capacity of the new Corporation smelter will be about 40,000 tons per year, which is about the amount by which its present production of spelter would fall short were the galvanizing operations of the American Steel & Wire Co., the American Sheet & Tin Plate Co., and the National Tube Co. to be run at full capacity. Through its subsidiary, the Edgar Zinc Co., which is tributary to the American Steel & Wire Co., the Corporation is a producer of spelter. Contracts have been closed for a 12 months' supply of Australian zinc ore for the new smelter.

Sheet-zinc was reduced April 22, to 27c. base, f.o.b. mill.

LEAD

The market has been demoralized, and the range of prices has been wide. On June 17, the largest interest was quoting 6.25c., New York. On June 18, it dropped its price to 6c., and June 19, it came down to 5.75c., which it continued to quote for several days, despite the fact that outsiders were asking down to 5.45c. It would have been natural for the high and low prices to have drawn more closely together, but they had not done so up to June 24. A peculiar phase of the market was the many offerings by consumers who had contracted for more than they needed in the panic which prevailed when prices went to over 7c. per lb. It is estimated that thousands of tons were taken at between 6.50 and 7c. Most of the would-be sellers found little or no acceptance for the metal they offered. It is now seen that consumers bid the market up on themselves and the producers took advantage of a situation most profitable to them. Independent producers were supposed to be sold up, but the market was too tempting for them to forgo selling. In the excitement of the rapidly advancing market, the independents asked and obtained higher prices than those of the Trust. Following the break, they asked lower prices, while still lower prices were asked by consumers, dealers and jobbers. Independent sellers of lead, June 25, advanced their asking price from 5.45 to 5.75c., New York, thereby putting their quotation on the same level as that of the A. S. & R.

The exports of lead between June 1 and 25 totaled 6586 tons (tons of 2240 lb.) The exports of domestic lead in four months of this year totaled 33,292 tons, against none in the same period last year. The April exports totaled 17,755 tons. According to a cable from London, the A. S. & R. Co. has withdrawn from the English syndicate which regulated the sale of lead abroad. It is understood that the company will conduct its business independently of the syndicate.

TIN

The week has been uninteresting in this metal. Trading has been dull, and the price declined until on June 23 it was 41c., where it stood also the following day. The highest daily average reported in the week, June 16 to 23, was 41.50c. The market was unquestionably affected by the slump in lead and spelter. The arrivals up to June 25 were only 2110 tons. There was afloat on that day 6502 tons, a good part of which was scheduled to arrive in the month. Meanwhile consumers are comfortably supplied.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz -20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha	10½
Red Crown gasoline	11½		

	Per bbl
Calol fuel oil, f.o.b. Richmond Refinery	$0.85

	Per ton
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked* subject immediate delivery.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	*$65.00	$90.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	425.00	450.00
Tungsten ore, 65%	*450.00	540.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	subject negotiation	

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	4.75	5.63
Borax, powdered, bbl., per 100 lb.	5.25	6.10
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.75	12.50
Lead acetate, white broken, casks, per 100 lb.	10.87	13.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, com'l, per 100 lb.	8.75	9.25
Litharge, C. P., silver free, per 100 lb.	13.00	15.00
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	130.00	140.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	15.00	16.00
Nitre, double ref'd., granular, bbl., per 100 lb.	15.00	16.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	15.00	16.00
Potassium bicarbonate, cryst., per 100 lb.	22.00	25.00
Potassium carbonate, calcined, per 100 lb.	25.00	35.00
Potassium permanganate, drum, per lb.	0.70	0.75
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	3.00	3.25
Soda, caustic, solid, 98%, drums, per 100 lb.	2.80	3.00
Zinc shavings, 850 fine, bbl., per 100 lb.	34.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations

The marketed production of phosphate rock in the United States in 1914 was 2,734,043 long tons, valued at $9,608,041. Compared with the production of 1913, which was 3,111,221 tons, valued at $11,796,231, there was a decrease amounting in quantity to 377,178 tons, or 12%, and in value to $2,188,190, or nearly 19%. As compared with 1912 also there was a decrease in 1914 of 8% in quantity and of nearly 18% in value. The production of phosphate rock has been steadily increasing for many years, with an occasional exception, until 1914, when, for causes chiefly outside the country, a diminished output has to be recorded.

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

CAUTION marks business policy in general. Money is not in demand. Hesitation is still manifest, despite good crop prospects and a slight improvement in railroad earnings. The trend of events favors the mining industry.

PLATINUM export in quantities valued at over $250 was placed under an embargo by the Russian government early this year, in the expectation of encouraging the opening of domestic refineries. This hope has been falsified; the producers have platinum they cannot sell, and are now petitioning for a modification of the embargo.

POTASH SALTS are much needed for making fertilizers. In 1914 the United States imported $8,743,973 worth. Other ingredients of fertilizer manufacture to the value of $25,000,000 more were imported during the past year. Potash salts have been found lately in Arizona and Oregon, but the extent and quality of the deposits are yet to be proved.

GOLD from the South African, the West African, Indian, and Australian mines is being accumulated near the places of production, for the British government arranged early in the War to advance 97% of its value to the companies producing it, the payment being made in London. This gold, on the average production, represents about $28,000,000 per month. If it had been stored for the 12 months now nearly past, it would represent a sum of $336,000,000.

WE READ of a party of miners working the Sultana mine in Utah who had not kept informed concerning the metal market, so that after two months' operations they returned to Salt Lake City to find that the lead in their ore had risen from about 4 to 7 cents per pound during the interval. Fortunately they had benefited by ignorance. Another time they might suffer as much for the same reason. We commend our page, published weekly, on the metal markets to the operators of mines as giving reliable information on a subject vital to them.

ANTIMONY, in the form of the sulphide, stibnite, is plentiful in Kern county, more especially in San Emidio canyon, also near the Tehachapi pass, and at Mohave, which is just over the line in San Bernardino county. In 1884, S. Boushey and his associates worked the San Emidio mines, and subsequently Starr & Mathison built a refinery in San Francisco to treat the product. This refinery was operated for several years and only failed because of the prejudice for 'star' metal, although that produced in the local plant was identical in character. So the antimony had to be shipped to New York, and the freight killed the business. In California antimony is associated in nature with mercury; hence it is also found in Napa, San Benito, and San Luis Obispo counties.

BALANCES of trade have averaged $140,000,000 per month in favor of the United States for the last seven months. Despite the liquidation of American securities in Europe, about $120,000,000 of gold has crossed the Atlantic to balance the account. Further selling of American investment stocks is certain, with a corresponding influx of gold hither. This fact is now engaging the serious study of financiers, for it is feared that it may lead to a dangerous inflation. The recognition of the danger is a good sign.

WE take pleasure in publishing an article by Mr. E. Gybbon Spilsbury giving our readers some of his technical reminiscences. If he had not confessed to being engaged on the inspection of a mine on the day when the present writer was born, we would not have disclosed the fact that he is indeed a veteran, although we were fully aware that for 50 years he has commanded the respectful attention of his professional friends. Mr. Spilsbury has the secret of a youthful spirit: the ability to take an interest in the affairs of others. His many friends will be delightfully reminded of him by reading the article and will join with us in wishing him continued health and prosperity.

TIN-SMELTING will soon be a domestic industry. As stated in our correspondence from New York recently, the American Smelting & Refining Company has a plant under construction at Maurer, New Jersey, while Williams, Harvey & Co., the principal English smelter of Bolivian ore, has announced that it also will build a smelter somewhere in the United States. We are glad to add that a proposal is on foot to build a smelter in California, to treat Bolivian ores as well as the tin concentrate from Alaska. The principal use of tin is the making of tin-plate, which is used mainly in the making of cans for preserved fruit, foods, and oils. California, with its great petroleum output and fruit-growing industry, furnishes a large market for tin-cans, as does the salmon of Alaska, and the pine-apples of Hawaii. There is thus a local market for tin products, but a tin smelter would need as a corollary a tin-plate

mill. Probably the one would be built if the other were in existence. Crude oil is available here at a low price for smelting the ore, and the development of this local industry seems quite feasible.

PAN AMERICAN Scientific Congress is the name of an international meeting convened for December 27 next at Washington. It is a sequel and a confirmation of the recent Financial Conference, which appears to have paved the way for closer industrial relations between the Americas north and south of the equator. That was a business men's affair, while the forthcoming Congress is to be educational and scientific. A similar convention was held at Santiago, Chile, in 1908, and at that time Washington was designated as the next place of meeting. Among the departments of science to furnish subjects for discussion is one entitled 'Mining and Metallurgy,' in charge of a committee of which Mr. Hennen Jennings is chairman. That fact speaks for itself. We make mention of this convention early so that those finding it convenient to be near Washington at the end of the year may arrange to be present and to participate.

LOCAL papers have stated that Mr. H. C. Hoover "will take over the management" of the Oroville Dredging company. This error is due to confusion with Mr. Theodore J. Hoover, his brother, who is a director of the company mentioned. However, even then the published statement would be erroneous, for the change made recently, whereby the control has passed from San Francisco to London, is of a nominal character. The fact is that the company's alluvial property at Oroville is nearly worked out; the enterprise was rejuvenated, about three years ago, by the exploitation of a new dredging property, called the Pato, in Colombia. This is doing well, but as 90% of the Oroville shares are held in London, the Californian interest in this South American dredging ground is slight, although it is pleasant to note that the technical work is still in the hands of Californians, notably Mr. W. A. Prichard, who is consulting engineer to the Pato. This offspring of the Oroville has itself given birth to a later subsidiary called the Nechi, another dredging enterprise in the same district as the Pato. It is obvious therefore that the original financial and technical interests of the original Oroville dredging company have passed elsewhere, and with this passing goes the management. It is the logic of events, nothing more.

EXAMINATION of metals by means of X-rays has been developed in the experimental laboratories of the General Electric Company, and Mr. W. P. Davey will present a paper on the subject at the International Engineering Congress, to be held in this city in September. While a radiograph gives no information as to the crystalline structure of the metal, it serves to indicate the presence of blow-holes, slag inclusions, porous spots, and similar defects that could not otherwise be detected except by cutting into the metal. Thus, for example, plates $\frac{3}{8}$ inch thick, welded by means of an oxy-acetylene flame were examined and defects in the weld easily detected. In steel $\frac{5}{8}$ inch thick an air inclusion only 0.007 inch wide could be discovered. Unfortunately none of the fluorescent screens now in use are sensitive enough, so that all the work must be done photographically. On account of the length of exposure required with X-ray tubes of the voltages now in use it is not practicable to photograph through greater thickness than $\frac{1}{2}$ inch, but with further development, higher voltages may become feasible.

COST of living in South Africa, so it is claimed by the Labor Union on the Rand, has increased to such an extent as to warrant a demand for a 20% rise in the wages paid to contractors and a 25% rise for day's-pay men. The demand comes at a moment so inopportune as to look like a hold-up, but it has been met judiciously by the Chamber of Mines, which has replied that the cost of living in the Transvaal has increased to no such degree as that claimed, while, on the other hand, the market-value of the product of the mines, namely the gold, has not been and cannot be increased to the consumer. A rise of 20 to 25% in wages would augment the cost of production by 1 shilling, or 25 cents, per ton, so as to put nine mines on the ragged edge of solvency, and thus endanger the employment of 1670 white men. Hence the Chamber of Mines demurs to any hasty action and suggests an investigation by a committee of representative employers and employees under a chairman to be appointed by the Government. This is a reasonable and politic solution of a threatening difficulty.

The Mid-Year

For the first time the Secretary of the Interior has issued a mid-year review of business conditions as reflected by the mining industry. By calling upon the agents of the Geological Survey in the different mining centres, he has been enabled to issue a valuable summary of opinions. We publish the one emanating from Mr. Charles G. Yale here in San Francisco. It speaks for itself. Mining in California is awakening to renewed activity. In regard to the copper industry of the country, the period of restriction of output has ended, most of the large mines having now brought their output to normal capacity. Many of the smaller producers, which were compelled to shut-down a few months ago, have resumed work. Mr. B. S. Butler's report on the subject summarizes the position by saying: "The output of copper has probably nearly or quite reached the normal. Wages have been raised where reduction had taken place and the industry in general is in a highly prosperous condition." As to lead and zinc, Mr. C. E. Siebenthal reports that a marked revival in the mining of these metals has followed the rise in prices. "The present smelter capacity is scarcely equal to the demands upon it. This renders it imperative that as much spelter as possible be produced per retort, and puts a premium upon high-grade ores." He explains that this means a

55 to 60% zinc concentrate. The lack of smelter capacity has caused several old coal-fired plants to be restarted in Kansas and Missouri. The Joplin district especially is booming; also the Miami district of Oklahoma. Better quotations for lead are also helping the zinc mines, for most of them produce both metals. Lead itself has been kept quiet by the stock accumulated during a dull period, but much of this has now been sold. Mr. F. L. Hess reports upon antimony and speaks of the 'boom' in that metal. The demand for it and the British embargo on exports have caused the best brands to rise from 7 cents before the War to as much as 40 cents per pound. The Chinese output, on which this country largely depends, has been increased, but it does not suffice. The Chapman Smelting Company has resumed in San Francisco, and a new smelter has been erected near San Pedro, to work ore from mines near Ballarat, in California. From Alaska and Nevada also some antimony has come, but the fear of a drop in the price of the metal as soon as the War is over prevents search for new deposits, although, of course, if a mine containing high-grade ore were found it could be run profitably even at the normal price.

References are made in a report, also by Mr. F. L. Hess, to the erection of the tin smelter at Perth Amboy by the American Smelting & Refining Company, to treat Bolivian ores at the rate of 3000 to 5000 tons per annum. This should prove helpful in any effort to exploit the meagre tin resources of this continent. Tungsten and molybdenum are now in great demand, owing to the requirements of the steel industry. The first American molybdenum mine to be worked on any scale is that of the Primos Chemical Company near Empire, in Colorado, while tungsten is also being exploited at a number of mines in Boulder county, Colorado. The quicksilver industry is one concerning which we have had a good deal to say in these columns. Mr. H. D. McCaskey, confirming our statements, refers to the rise in price from $40 to $90 per flask, and mentions the cessation of shipments from Italy when that country went to war. He concludes that "the domestic mines are without serious competition and are in a position to profit while the War lasts." The demand for explosives is abnormal and the few producers of mercury in California, Nevada, and Texas "will find some difficulty" in supplying the market. Mining for gold and silver, says Mr. McCaskey, is in a normal condition. Any danger of a shortage of cyanide has disappeared, the domestic production of that necessary chemical having been increased "under the freedom from foreign competition." A lower price for silver, which has fallen from an average of 55 cents in 1914 to below 50 cents, is noteworthy. It remains only to quote the final remark of the Secretary of the Interior, Mr. Franklin K. Lane. He says: "The mining industry is basal in its relation to the general business of the nation and these generally optimistic reports from all parts of the country are significant and assuring to all who desire the industrial advancement of the United States."

Big Business

An honored correspondent writes to us expressing the opinion that the depressed condition of the mining profession has been produced by the consolidation of mining and metallurgical enterprises. He holds that whereas formerly a hundred men found occupation in a score of small operations, now, in these days of vast agglomerations of capital, one-tenth the number suffices. Economy, you say. No, says he. In one sense perhaps, namely, the cost of production, but as the millions that compose our population are forced into strictest economy through the contraction of employment, they have no money to spend, and hard times ensue. It was so before the War. The trouble, he insists, began with the large consolidations, which naturally threw thousands of men out of employment. What is the use, he asks, of reducing cost if at the same time people are deprived of the means wherewith to purchase? The only corrective, he suggests, is to go back to small operations. In the mining districts such a state of affairs can be brought about by showing small operators how to make their mines profitable. That, he concludes, is one of the functions of technical journalism, particularly of a paper like the Mining and Scientific Press, which is nearer the mines than any other on this continent.

That is an appeal to which we respond. It is one that will evoke the sympathy of most of our readers. But first let us consider the premises to the argument. Big consolidations stifle small operations and depress the vitality of the mining profession. That is the statement. Remembering the days when a million tons of ore was a visionary quantity and recalling a period when a $100,000 mine was a respectably large enterprise, we are able to make necessary comparisons. Then $5000 was a handsome salary for even the cleverest engineer, and many of those thus recompensed worked cheerfully in charge of relatively small mines, as against the few who now receive $5000 per month and supervise the operations of an enterprise that includes a dozen or twenty mines consolidated into one property. Yes, the picture of a dozen 40-stamp mills crushing ore from an equal number of mines is attractive as against a 100-stamp mill crushing five times as fast for a single consolidated property. But those 40-stamp mills were supplied with richer ore than the big fellow and the latter earns a small profit from stuff that his predecessors would have found unprofitable. Mere bigness is not attractive, but it must be confessed that the large-scale operation is often necessary to furnish an economic basis of production. The disseminated copper mines with their 2 to 2½% ore are making fortunes for their proprietors by exploiting lodes that were intelligently diregarded in an earlier period when such ore afforded no economic attraction even to a skillful and experienced engineer. It was the improvement in concentration practice, plus the devising of suitable methods of mining cheaply, that brought these deposits within the definition of 'ore.' Before that they possessed only an academic interest. The copper mines of Ely furnish a good example. For many years small mines working

restricted and uncertain bodies of high-grade ore existed precariously, with more failure than success. When a broad-gauge engineer realized the conditions and adapted his methods to them, by steam-shovel and concentrator, these unhappy ventures were joined into one superb undertaking, involving much capital and the building of a railroad, but developing into an enterprise of commanding merit. This story was repeated at Bingham, and elsewhere, notably in Arizona. No, we cannot glorify the past in an economic sense, much as we sympathize with the human extinction that follows in the wake of material aggrandizement. Yet we realize the advantage to the home community of smaller enterprises owned and operated domestically. We have an example in the Mother Lode mines. These are small, compared with the Modderfontein, the Homestake, or the Treadwell, but they go ahead year after year giving employment to a resident population and to a number of local engineers, with results highly advantageous to the state of California. Those connected with them prefer to operate themselves rather than sell out to capitalists on the outside. The pleasure of the work, and a confidence in their own ability to perform it, prevents them from considering the transfer of their property. At the same time the gold lodes are such as not to justify the belief that they can be exploited more profitably by mere enlargement of the scale of operations. The general result would please our correspondent. Here the big consolidation finds no foothold. Yet at Grass Valley the main portion of an old gold-mining district has passed under the control of two companies, which have absorbed the adjacent smaller companies that used to operate there. No reason exists for believing that the community has suffered thereby, for those smaller companies had come to the end of their tether in most cases before they were swallowed by their present successors. Here we come to one of the advantages of consolidation; stability of enterprise. By averaging good and ill luck over a large area of mineral territory the consolidation escapes the unproductive years that kill a small property. The element of risk is lessened.

And yet we feel some sympathy with our correspondent's argument even though the logic of facts tends to refute it. Indeed, we want more of the smaller enterprises, if only for the reason that from them are incubated the bigger ones. Men have not yet learned perhaps that to manage a small mine of your own is more interesting, and sometimes more profitable, than to hold a block of shares in a consolidation that puts you aside as a passenger, no longer a navigator. Many a man that was leading a happy life in the busy occupation of managing a mine, which he controlled, has exchanged that status for the idle possession of a shareholding that left him nothing to do except watch the tape. Each man must be his own philospher. From the community point of view the capable mine operator is more desirable than the same man when he has become a gambler on Wall Street; the one develops a natural resource, the other uses it as a counter in a game, which usually, like Bill Nye, "he does not understand." The conditions of which our correspondent complains should correct themselves. The small operator sold out when he got more by selling than by operating. Formerly there was more money made by selling than by buying mines. Now purchasers are more wary, they are better advised, and they decline to discount an unknown future too liberally. The time may come, indeed the consolidators complain that it has come, when mines cannot be bought advantageously. Then the small operator will refuse to do business with the consolidator, who has become so exacting, and will pursue the even tenor of his way, working his small mine cheerfully without the hankering to 'cash in.' In short, the incorrigible law of supply and demand will adjust the difficulty.

Australian Metal Trade

An official statement, prepared in the office of the Federal Attorney-General, gives some interesting statistics concerning the metal trade of Australia. The year 1913 is taken as typical. Of the lead produced at Broken Hill, 208,000 tons, just 50% was treated locally, the other half being exported, under the control of the 'Lead Convention.' Of the metallic lead exported, a large proportion goes to China. Of the zinc, 89% of the output (188,270 tons) was exported to a German group, consisting of the Metallgesellschaft, Aron Hirsch & Sohn, and Beer, Sondheimer & Co. Of the copper produced by the leading Australian mines, 95% was controlled by the German companies, notably Aron Hirsch & Sohn and Brandeis, Goldschmidt & Co. The Great Fitzroy and Chillagoe companies shipped their product to refineries in the United States, where the copper passed to the American Metal Co., which is associated with the Metallgesellschaft at Frankfurt. Taking the production of the principal base-metal mines of Australia, 80% is exported and controlled by German metal agents. So says this official report, prepared in connection with an inquiry arising out of the War. All we need say is that it furnishes a scathing comment on the lack of enterprise, first of the Australian and then of the British. Of course, the consumption of metal in Australia is, relatively to Europe, small; yet much of it is exported as raw material to return as a manufactured product. Not even sheet zinc was rolled until the War made it imperative. As regards the British position, it is a fact that Great Britain consumes an amount of zinc exactly equal to the Australian output and consumes twice as much lead as that derivable from the Broken Hill lead concentrate that passes her ports on its way to the Continental smelters; while as to copper, Great Britain uses 140,000 tons, or three times the Australian production. One cannot but admire the enterprise of the German ore-purchasing agencies, which have been able to make such a successful industrial invasion of a foreign mineral region. At the same time, viewing the matter in a broad way, it is undesirable that ore-producers anywhere should be under the thumb of cartels, conventions, or syndicates so concentrated as to be able to control not the output only but the market price of the metals.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more vaulable than casual compliment.

Speculation in Mines

The Editor:

Sir—It has never occurred to me that the question of speculation in mining enterprises turned in any way upon the factor of venture *per se*. If the nature of mining has made it attractive to questionable promoters, surely no discussion should be necessary to eliminate all such and to put absolutely aside the too numerous peddling schemes that wholly lack the element of good faith. The fact that such gentry have flourished in the United States, and have given some excuse for the sneering attitude of financial authorities toward mining has nothing to do with the soundness of mining as an industry. For some reason, not germane to the present subject, financial approval has been given most freely in this country to railroad securities; yet these have found a fairly rocky road to travel, with frequent reorganizations that, of necessity, have fallen most heavily upon those least able to protect themselves. Until the average shareholder in American corporations comes to realize that he must expect the treatment accorded to a sheep, if he insists upon playing the rôle of a sheep, the evils of which he complains will continue. There never has been, and, so long as human nature continues to be an imperfect thing, there never will be, evolved a system of jurisprudence that will remove the requirements of self-protection.

If mining does not hold the place it should in the ordinary layman's classification of the sources of wealth, it can only be due to ignorance, the ignorance traceable to a distinctly American habit of letting others do the thinking for the man in the street. Miles Standish and Caesar agreed in the saying that "if you want a thing well done, you must do it yourself and not leave it to others." As Americans we have largely refused to shoulder our financial and political duties, but have "left them to others." It would be quite unfair to accuse the American public of a lack of intelligence, but is quite true that as a whole that intelligence is not used as fully as it should be. All forms of business activity depend primarily upon the uninsurable business risk. The timid man who seeks to protect himself against every possible contingency of loss must be content with an extreme minimum of profit. Such men are never creators of anything, yet this is the type that condemns all mining as unduly venturesome when he happens to learn of some unwise or dishonest promotion coming to an inevitable end.

It has been suggested in the discussions of preceding contributors that if the financial managements of mining companies could raise money by assessment, when needed, it would go far to cure some of the present-day troubles. I am inclined to the opinion that in so far as this is a step toward more complete co-operation, it is good, but the principle should be carried further, if possible. I have always considered that the best and most satisfactory results in mining could be obtained through properly organized development companies, with a staff that would pride itself upon the number of properties it developed rather than upon those which it rejected.

Writing as a student of conditions and without the least desire to criticize without cause, I am inclined to think that engineers have developed an undue fear of failure; it has become almost impossible to get a recommendation that expenditure be made upon a property that cannot absolutely demonstrate its ability to re-pay at least all such outlay. The result is a deadlock, with development companies reporting, and apparently taking pride in the report, that large numbers of prospects in various stages of development have been 'turned down.' Rejections do not count, but prospects turned into mines do. The investor, with but the one string to his bow—a holding in a single company—is perhaps justified in his sense of discouragement, when the vein pinches out. If, however, the same capital is in the form of a holding in a development company, with adequate resources, a good staff, and some aggressive spirit, he can feel that one failure is of little moment.

It may be replied, with truth, that we have not enough of such organizations, or that those that do exist lack some of the qualifications requisite for successful operation. On the other hand, those organizations that have to some extent adopted this course and shown themselves capable have no lack of followers.

The moment a good organization comes into being and is ready to demonstrate to the public that the only risk which the shareholders will have to face will be that of legitimate mining, of finding and treating the ore at a profit, it will discover a public that will never complain of any failure made in good faith, but will remember and applaud every success, nor will it unreasonably expect that "every post shall be made a winning one." Inside options must be eliminated, and the work of excavation must be done on mining properties and not in the way of making ground-floors and sub-cellars. This completes the cycle: it is up to the investor to insist upon these conditions and not expect that others will serve him where he should serve himself.

When engineers are ready to say that they cannot expect to be infallible, that it should not be expected of them, and that such expectation compels them to take no chances and consequently get nowhere, but that in the long run they will be right often enough to show satisfactory profits for their financial sponsors, then mining will begin to have at its command the resources it deserves.

C. S. Burton.

New York, June 15.

Gold Mining in Bolivia

The Editor:

Sir—The department of La Paz unquestionably contains the richest gold placers in Bolivia, and it is also regarded as being the richest in gold veins. Among its nine provinces, Inquisivi is supposed to be the richest. The western boundary of Inquisivi follows for a long distance the summit of the eastern Cordillera, descending toward the east and north. The province is exceedingly rugged, transversed by many mountain ranges and corresponding deep canyons, accessible only by trails. Although the Bolivian government, besides its extensive railroad system, is building good wagon-roads, and has now nearly 1000 miles constructed, Inquisivi has the smallest ratio of good roads, on account of the difficulty of establishing an easy grade. Inquisivi for a long time has had more road accidents recorded than all the other 51 provinces of Bolivia together.

The many tin mines in the Quimsa Cruz district were difficult of access; now there is a stage-road in operation from a station on the Bolivian state railroad in Sicasica, across the Quimsa Cruz pass, down into Inquisivi, with many branch-roads and trails to about 20 different tin mines.

According to the 'Monografia de la Industria Minera in Bolivia,' by Pedro Aniceto Blanco, published by the Bolivian government at La Paz in 1910, there is a group of three rich gold mines in Inquisivi. These are the Havara, the Sacambaya, and the Cutavito, established and operated for many years by the Jesuits with great results. Notwithstanding the long war of Independence, lasting from 1781 to 1825, the gold and silver mines made a good production, and it is supposed that these three mines also were in operation until 1825. Large sums of gold had accumulated, which the Jesuits could not take along with them, and on leaving, they buried it in the vicinity of the Sacambaya mine. In most cases a caretaker was left behind to look after the properties, as the Spaniards hoped to return eventually with a new army to re-conquer the country. Another rich gold mine, with a wonderful production, was the San Juan Bautista, also supposed to be in the mining district of Chuquircamiri, in this same province of Inquisivi.

About 1846, Jose Maria Dalence was directed by the President of Bolivia to explore the whole country and compile a list of all the mines and placers. For this purpose he was provided with a number of old maps. His report, published at Sucre (Chuquisaca) in 1851, is entitled 'Bosquejo Estadistica de Bolivia.' Dalence had also been charged to find these three mines and the buried treasure near the Sacambaya. But the whole landscape had been so much changed by the forests that had grown up that he could find none of them, nor the San Juan Bautista. Besides, the inhabitants had all departed, nor could he obtain any help, guides, or provisions.

P. A. Blanco has published, with his book, a map showing the position of the most important mines, but none of these four mines, nor even their respective districts, has been indicated. I have an assortment of maps bearing on Bolivia. On one of them the district of Havara in Inquisivi province is shown; there is also a village of that name. I would have no difficulty in finding the Havara district.

As to the authenticity of these three mines, I may mention that in 1546, at the Royal Villa at Potosi, a book of record was kept, giving the names and owners of all the gold and silver mines in Bolivia (then called Peru Alto), with the yearly production up to 1825, for the collection of the 'Royal Fifth,' to be sent yearly to the treasury of the king of Spain. These records have been transferred from Potosi to the Government archives at La Paz. It is known that every year a copy of these yearly records had been sent also to the Royal Treasury at Madrid, and that subsequently these records had been transferred to the Royal Library, so a Bolivian Commissioner with copies of the La Paz records was sent to Spain to compare his copies with the records preserved at the Royal Library at Madrid. The Commissioner received permission to do this and found that the records of La Paz agreed fully with the records of Madrid, and are, therefore, authentic. It is evident that there cannot be any question as to the existence of these three gold mines and the authenticity of their production figures.

On June 12, 1666, a great revolt of the Indians of Bolivia broke out, during which the San Juan Bautista mine was completely destroyed. The Spaniards had to flee. The Indians defaced the portals of the adits, destroyed the reduction works, all the dwellings, broke the aqueducts, and for years had guards stationed for miles around to prevent any Spaniard from coming near. Nature finally helped, for the tropical rains caused the chaparral and forest trees to obliterate the trails and the fields where the Indian women were forced to raise the corn to feed the mine-population, now departed to other parts of Bolivia. The destruction of the three mines in the Havara district followed 115 years later.

There would not be much difficulty in discovering the Havara, Sacambaya, and Cutavito mines by searching for the ruins of reduction works, dwellings, broken aqueducts, flumes, frequently hewn along the mountainsides from solid rock and leading to large cisterns, *quimbaletes* (rocking-stones for fine crushing of ore), and the accumulations of immense waste and tailing-dumps; all these objects would not be effaced in a thousand years. Much information can be collected from the natives and also from descendants of the early Spaniards. Many of these were engaged in farming and trading; not having taken part in the war, they had nothing to fear from the

Indians. In actual war-time, they absented themselves, but always returned to their homes. As a rule, these Spanish descendants kept up the family records, and by getting in touch with them much information from former times can be obtained.

The result of finding some of these gold mines would be the obtaining, from the Government, of a leasehold at the rate of 2 Bolivianos (80 cents) per hectare (2.47 acres) per 6 months. So long as this leasehold tax is paid, the company is in undisputed possession of the property. Wages are low, about 80 cents per day, the workman buying his own food. Bolivia is a member of the Postal Union and parcels can be sent to the United States, up to a weight of 10 lb., for 12c. per lb. There is also a large banking and commission firm with many branches in Bolivia and main offices in New York and San Francisco, that could attend to the shipment of bullion. All iron-work and machinery is admitted free of import for mines, concentrators, mills, and smelters. The mining laws are good and the United States government maintains a legation at La Paz.

Berkeley, California, June 12. G. W. Wepfer.

Assay of Ore Containing Metallics

The Editor:

Sir—In his letter, 'Assay of Ore Containing Metallics,' in the issue of June 5, W. E. Cahill describes a modification of the usual method of assaying ore containing metallics. Mr. Cahill states that by adding pulp to bring the total up to one-half assay-ton it is not necessary to weigh the metallics in order to make the calculation for its equivalent weight in pulp, as that is automatically done. While this is not apparent from his discussion, the following mathematical computation shows it to be true.

In the usual method, assaying the pulp, finding the total gold in the pulp, finding the amount of gold in the metallics, and then distributing the total gold over the whole sample, if

P_1 = the weight of pulp in grams,

P_2 = milligrams of gold per assay-ton of pulp,

M_1 = the weight of the metallics in grams,

M_2 = milligrams of gold in metallics,

T_1 = the weight of the sample in grams = $(P_1 + M_1)$,

then the amount of gold in ounces per ton (of 2000 lb.) of sample is

$$\frac{(P_1)(P_2)}{T_1} \qquad \frac{(29.166)(M_2)}{T_1}$$

This corresponds to the formula on page 259 of Furman's 'A Manual of Practical Assaying.' Transform this into Mr. Cahill's method by separating the expression into two terms having a common denominator. The first term $(P_1)(P_2)/T_1$ can be written $P_2 - (1 - P_1/T_1)P_2$ or $P_2 - (T_1 - P_1)(P_2)/T_1$ or $(A + B)_2 - (M_1)(A + B)_2/T_1$. The second term of the expression $(M_2)(29.166)/T_1$ represents the amount of gold in the metallics divided by the assay-tons in the sample. In terms of Mr. Cahill's method this can be written $[G_2 - (\frac{1}{2}$ A.T. of pulp − weight of metallics) $(A + B)_2/29.166]$ 29.166 T_1 (G_2 being total gold from pulp plus metallics to $\frac{1}{2}$ A. T.; the expression in parentheses being the actual amount of pulp $(A + B)_2$ 29.166 the milligrams of gold per gram of pulp) or,

$$\left[G_2 - \frac{(29.166)}{2} \cdot \frac{(A + B)_2}{29.166} + \frac{M_1(A + B)_2}{29.166}\right] \frac{29.166}{T_1}$$

or,

$$\left[G_2 - \frac{(A + B)_2}{2}\right] \frac{29.166}{T_1} + \frac{M_1(A + B)_2}{T_1}$$

this last portion of the second term is seen to cancel with the second part of the first term, this being the automatic adjustment of Mr. Cahill's method. Collecting terms the formula is,

$$(A + B)_2 + \left[G_2 - \frac{(A + B)_2}{2}\right] \frac{29.166}{T_1}.$$

Substituting figures given, then $(4.48 + 4.52) + [94.50 - (4.48 + 4.52)/2]$ 29.166 292 or $9 + (90)(29.166)$ 292 = 17.989, or practically 18 oz. per ton.

Mr. Cahill's method affords considerable advantage over the usual method both in procedure and computation.

Reno, Nevada, June 15. J. J. Bristol.

The Mechanical Work of Crushing

The Editor:

Sir—In the article by H. C. Kenney, in your issue of April 10, there seems to be a serious lack of 'precision of thought.' On page 573 the author takes the theoretical case of a knife cutting a soft cube. I fail to see what this has to do with crushing ore—we *crush* ore, we don't *cut* it. All fracture is finally caused by tensile strength, but the work required to produce the necessary tension varies with the manner in which the force is applied. Thus in the case of compression (or shearing), the deformation (as Mr. Kenney states), is proportional to the dimension of the test-piece in the direction of the application of the force, and the work is proportional to this deformation.

In the case of cutting, the knife stretches the surface layer till it breaks. The work is measured by the distance the knife has to travel before rupture occurs, and this is quite independent of the dimensions of the test-piece. Thus the work required in each case is not necessarily the same. To say that any mechanical means can "sever the molecular bonds without causing distortion," is to deny that "strain is proportional to stress." Otherwise it means that an infinitely sharp knife can cut materials without the exercise of any pressure on the blade; in other words, that it can cut without doing any work. The rest of page 573 is based on this fallacy. Confusion again appears in the attempt to differentiate between "work of compression" and "work of rupture." The work is done in compressing the body up to the point of rupture. When this is reached an infinitesimal increase causes rupture, and no more work is done. The potential energy of compression changes to heat, to surface tension of the new faces, and to electrical forms of energy.

Walter J. Rose.

Broken Hill, Australia, May 18.

Technical Reminiscences

By E. GYBBON SPILSBURY

When asked by the Editor to contribute some reminiscences of my technical experience, I could not but wonder how much age had to do with this request. Knowing how careful the said Editor is in the use of his own experience, I felt that nothing short of real ancient history was expected under the title of "reminiscences," and, therefore, to reach back that far I shall have to begin at the date of his own birth.*

At that time I was representing an important German zinc and lead mining company, on the island of Sardinia, investigating the zinc resources of that island. Captain Thomas Rickard and his brother Richard reached the island about the same time in the interests of the mining firm of John Taylor & Sons, of London. As we were the pioneers in the work of developing the immense calamine deposits only then just beginning to be known and appreciated, and also being practically the only English-speaking engineers in the country, we were naturally thrown much together, and although our interests were somewhat opposed, personally we became quite intimate, and I well remember the invitation I received at my camp one day to come down to the town of Iglesias and dine with the Rickards to celebrate the advent of "young Tom" on this mundane sphere, the news of which event had just been received from Spezzia, where the family then was. Needless to say, I went and we did!

This early pioneer work in Sardinia was most interesting and instructive. In the first place, the island was almost as much a *terra incognita* as our own West a century ago. The only towns were along the coast and there were only two roads on which wheeled vehicles could be drawn; the one connecting Cagliari in the south with Sassari in the north, and the other connecting Cagliari with Iglesias in the south-west. All communication outside these two roads was by trail. And yet the civilization of Sardinia was one of the oldest in the world. Every district where mining became later developed had numerous workings of the ancients. The Phœnicians, the Egyptians, and later the Carthaginians and Romans had all left their marks, in old excavations, dumps, slag-piles, and more especially in the tombs, cut out of solid rock.

In those days, every old mine yielded no end of specimens of bronze tools and lamps, stone picks, and hammers made either of jasper or obsidian. The tombs yielded pottery of all sorts and scarabs of malachite and turquoise. The old slag-piles yielded lead slabs and pigs, with the Government seal and dates cast in them. Altogether it was a paradise for the archæologist, if not for the miner.

Mining for the first few years was conducted under difficulties, owing first to the unhealthfulness of the country during the summer months and secondly to lack of native labor. The prevalence of malarial fevers and cholera necessitated the cessation of all operations for the three summer months each year. All foreigners had to leave, even the imported labor from Piedmont could not stand the conditions. So that our calculations had to be based on a nine months' campaign. The natives themselves were more or less immune, but, owing to the peculiar tribal or village system under which they lived, they could not be induced to mingle with others not of their village and work in harmony with them.

The extent to which this segregation obtained through the island was really remarkable. The cause was attributed to lack of intercourse, due to the poor means of communication, but it was primarily attributable to the diverse origin of the tribes. Probably no region of equal area in any country contained so many different customs, costumes, and languages as existed in Sardinia at that time. General La Marmora, who wrote a history of the peoples of Sardinia, gives, I believe, 11 distinct languages as being spoken. One interesting case he mentions, and I verified it personally, was that of a community in the province of Sassari on the north-western coast, where the classic Latin is still the common language of the people. The costumes were varied and picturesque, and each village had its own. In the south the type was Moorish and the *bournous* was still worn. In some places the costumes resembled somewhat those of the Basques, but with more vivid colors.

In those days the north and eastern parts of the island were dangerous for foreigners as well as difficult of access. The tribes occupying this mountainous district did not recognize the Italian government and were generally classed as bandits. Many of them were so, being escaped convicts from the penal establishment near Cagliari. They had a government of their own, which, while not recognized by the Italian authorities, was winked at and not interfered with, except when some raid or other on the villagers of the lower country required a counter punitive raid by the *carabinieras* of the Italian army. As a rule these so-called bandits were a pretty decent set of fellows, as long as they received fair treatment.

There was one episode that I recall with much pleasure; it happened during the second year of my stay. I was camped near the village of Villa Cèdro, opening up a new mine, when one evening just when I was about to retire I heard a disturbance outside and the clatter of a number of horses. Thinking at first that I was about to be raided by the bandits, who were reported in the neighborhood, I called the two foremen who were in the house with me and getting our guns we started to see what the

*The Editor appreciates the joke and will take pleasure in signing the card.

trouble was. Opening the door, I saw a small cavalcade, some of which consisted of gendarmes, coming up to the house. The leader, a very tall and slim young gentleman dressed in full hunting costume, got off his horse and coming up the steps addressed me by name. Stating that he had a letter of introduction for me, he asked if he and a friend could stay the night. Of course, I told him he was welcome, if he could put up with our rough accommodations. He called to his friend and then entered the living-room, where there was a light. I thought I had never seen a taller or lankier fellow, but withal a most pleasant face. After getting rid of some of his wraps, he handed me a letter from one of the directors of our company asking me to do all that was possible to make the stay of the bearer as pleasant as I could, as he was a friend of theirs, being the Duke of Brabant, afterward Leopold the Second, King of the Belgians.

The Duke had come to Sardinia on a *mouflon* [mountain sheep] hunt, and as my camp was situated in the best mouflon country he stayed with me for several days. He never forgot the experience of that trip and years afterward when he had succeeded his father, I always received a hearty welcome whenever I met him either in Bruxelles or more often, in the latter years of his life, in Paris. A curious coincidence was that the last time I met him, about a year before his death, he was again in the Mediterranean, but this time at Messina on the island of Sicily.

At the time of my first visit to the island of Sardinia, the chief, if not the entire, metal products were lead and silver. These had been mined as far back as the time of the Phœnicians, and the extensive old workings as well as the slag-dumps showed the extent to which the business had been carried on.

The decline in the industry dated evidently back to the period following the dismembering of the Roman empire, as no relics of a subsequent date have been found, so far as I remember. In 1864 there were only two large producing mines operating on the island. These were the Montevecchio lead and silver mines in the central part of the island, and the Monteponi mines in the province of Iglesias in the south-western part. Both of these mines were treating galena as well as oxidized ores, while nearly all the old mines had worked only on the carbonate ores. About the year 1863 a new mining excitement seems to have been started, mostly by French prospectors, and concessions were obtained and capitalized on the ancient mines. This resulted in disappointments, as the mineral that was supposed to be cerussite turned out to be chiefly calamine.† This discovery, however, called the attention of the European zinc-smelters to these deposits as a source of supply, and in a few years Sardinia became the principal zinc-ore producer of Europe.

It was not long before the Monteponi Mining Co. began concentrating its lead ores more efficiently, saving the zinc silicate for further concentration and shipment. It was in carrying out this work that the presence of anglesite in large quantities in the lead veins was discovered, and a source of trouble in the smelting of lead carbonates was thus eliminated. Probably no other mine has produced as much natural lead sulphate as Monteponi, not only as cabinet specimens, but actually in bulk.

It may be of interest to note that the identification of the amorphous calamine of Sardinia was made possible by the discovery, a few years previous, of a similar cherty-looking mineral that occurred in a banded form in the Breinigerberg lead and zinc mine near Stolberg, in Rhenish Prussia. In the hand-jigging methods of concentration of those days, this material, which was much harder than the ordinary calamine, or zinc carbonate, was easily picked out and had been discarded as worthless until somebody out of curiosity analyzed it and found it contained as much zinc as the best carbonate ore.

The reduction of these silicate of zinc ores, however, offered no end of difficulties because the calcining, which by driving off the carbonic acid in the carbonate ores left that material in a porous condition and easily permeated by the reducing gases, had no effect on the silicates.

The principal markets for these zinc ores were in Belgium and Rhenish Prussia. Nearly all the zinc-smelters of these districts were either actually engaged in mining themselves, or were represented by buyers on the island of San Pietro at Carlo-Forte, which was the principal shipping port for all the ores mined on the western side of the island. The mines shipped their ores by lighter to Carlo-Forte and those not consigned direct were sampled there and sold at public auction once a week.

The method of shipping across the Straits was crude in the extreme. The ore was delivered by bullock-carts on the beach at Fontenamare, and when a shipment was ready it was loaded in baskets and carried out to the flat boats or lighters on the backs of men and women, who went into the water up to their shoulders before reaching the boats. The unloading at Carlo-Forte was done in the same manner. It was not till some years later that any mechanical loading devices were installed.

I wonder how many mining engineers of the present day can call to mind the changes and advances in the practice of mining which have taken place in the last half-century? Practically every appliance, beyond the pick and shovel, hand-hammer and drill, has been introduced during that short period. When I first started my practical course in underground work we knew none of the aids now considered requisite to work economically. We had no machine-drills to save the physical labor of hand-work. Dynamite or its precursor nitroglycerine had not yet been invented; fuse was still unknown; even steel was more or less of a luxury and our hand-drills were still made of iron with steel bits welded onto them. The mushrooming of the head of the drill under the hammer-blows was a constant source of trouble and injury to the hands of the miners. The only explosive known was the large-grained black powder.

†Here used for the carbonate. As our readers are aware, that is the European usage.—Editor.

It seems strange now to remember that part of the curriculum in the mining colleges consisted in instruction in how to prepare the cartridges of brown paper for the charge; how to waterproof them by soaking in tallow; how to prepare the long rye-straws for fuse and fill them with fine sporting powder; and how to prepare the slow fuse for ignition by soaking cotton wicking in molten sulphur and cutting it up into the proper lengths.

It seems hardly credible today, and yet it is a fact, that the contract price for driving or stoping ground was influenced by the condition of the rye crop. In seasons of drought the height of the rye was much curtailed, and the length of the straw between joints would be so short that the time occupied in jointing and filling the straws greatly lessened the driving capacity of the miners, and hence increased the cost per foot or per ton. Single-hand drilling was the general practice except in extraordinary hard rock, when double 'jacks' were used. The straw primers naturally limited the possible depth of a hole, and three feet was considered a good average. It was the invention of the tape fuse that brought the double-hand hammer into vogue, and made deeper drilling possible.

Lately there has arisen a good deal of discussion regarding the meaning of the terms 'tamping' and 'stemming,' the idea being that one designates the material used, and the other the method of introducing it into place. These terms, however, reach back to the straw-fuse period. 'Tamping,' from the French *tampon*, a plug, originally meant the material used for the plug, but was also generally used to express the action of inserting the plug. 'Stemming,' on the contrary, referred originally to a different part of the same operation, namely, the insertion of the copper stem or needle around which the tamping was driven so tight that when the needle was withdrawn it left a clear tube from the mouth of the drill-hole through which the straw fuse could be introduced and pushed home into the charge. The tamping-bar, which was copper-faced, was nearly of the same diameter as the hole, but along one side it had a groove in which the stem or needle would lie. What was known as 'stemming' in those days was the method of jarring the needle as the tamping progressed so as to make sure of its safe withdrawal without disturbing the completed tamping. This withdrawal was effected by passing a drill through the eye of the stem and using one end as a fulcrum, tapping the other end with a hammer until the needle was loosened sufficiently to be withdrawn by hand.

No detonating caps were used except in very wet holes. The end joint of the straw was split with a sharp knife before insertion, and the blow-out from the sporting powder was sufficient for the ignition of the charge. These straw fuses were very rapid and it was necessary to ignite them by a slow-burning sulphur wick. The choice of tamping material was not left to the miners, but was provided by the company, and the use of any other material rendered the miner liable to fine. As a rule the first plug next to the cartridge was of burnt clay, while the rest of the tamping was coarsely ground limestone.

A miner's equipment in those days consisted of a long tin tube to carry the lengths of straw for fuse and a sheath on the outside for the copper needle; this was the miner's own property; also attached to the main tube were smaller tubes or boxes containing the sulphur wicks, the sporting-powder priming, and the paper for cartridges; he also carried a flask of blasting-powder, and another smaller flask for oil, besides a water-flask, generally filled with coffee. All of these receptacles were inspected by the foreman as the men went on shift. In the German mines the men all assembled in the foreman's office for prayers before beginning their shift.

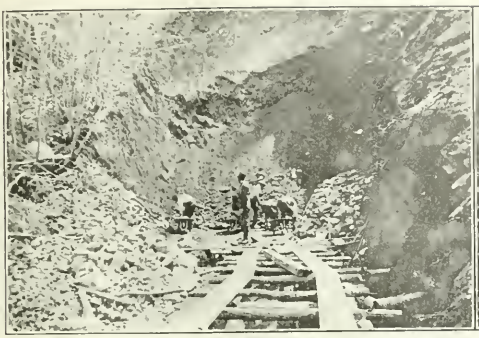
Except under special conditions no men were allowed to be raised or lowered by the hoisting-engine, the ladders being used both for entry and exit. In some of the very deep mines, however, a special man-engine or *fahrkunst* was used, greatly lessening the time spent in climbing ladders.

Mining Claims in National Forests

In many mining districts in the West there is some opposition to the practice of the Government in having claims within the National Forests inspected before the issuance of patent. Many mining men feel that they are entitled to patent to mining claims, particularly in established mining districts, even if they have not made mineral discoveries on the individual claims.

Congress has set aside a part of the public domain for a specific purpose—for the growing of timber, and the protection of the watersheds. The fact that any ground has thus been withdrawn is *prima facie* evidence that it has a definite value for the uses prescribed by Congress. Is it unreasonable for the Government to require mining claimants to comply with the Federal law before giving them absolute title to a part of its domain which has been designated by Congress as having a presumptive value for the purposes for which it has been reserved?

A prospector or miner is in no way disturbed by Government agents in the enjoyment of his rights within National Forests. No examination is made of any ground located for mining purposes unless, as stated, it interferes with the administration of the Forest. A claim may interfere with the administration of the Forest when it conflicts with areas leased to individuals under what is known as a Special Use Permit; when it is included within a tract from which the Government has sold, or contemplates selling, the timber; or where the claim is so located as to control rights of way over which it is necessary to transport forest products. At the present time, in some parts of the country, the timber business within the National Forests is seriously interfered with by unscrupulous locators of ground under the mining laws. In all such cases, the Government has a direct interest at stake, and an examination of the interfering mining claims is made to determine their validity.—E. D. Gardner in Trans. A. I. M. E.



EXCAVATING FOR THE DAM.

THE DAM ITSELF.

A Novel Debris-Dam

By LEROY A. PALMER

Gold was accidentally discovered in California in 1848. In 1849 fully 100,000 miners were washing the gravel in the streams and gulches of the Sierras. The pan was shortly followed by the rocker, brought from Georgia, then came the 'long tom' and the 'sluice-box.' With the sluices came the demand for some means of moving the gravel in larger quantities than before and an ingenious Yankee conceived the idea of directing a stream of water against the bank, using a rawhide hose with a cow's horn for a nozzle. This method was so effective that it was generally adopted and the crude apparatus soon developed into the steel penstock and the hydraulic giant of a later day.

The progress of hydraulic mining brought forth a problem that resulted in much bitter feeling and long continued litigation between the different interests involved. The first comers were essentially miners and sought gold regardless of the consequences that might attend their search. But the agricultural possibilities of the country were too great to be long overlooked, therefore many of the newcomers turned to this industry and much land was put to the raising of crops, the valleys watered by the largest rivers, the Sacramento and the San Joaquin, being the first and most thickly settled.

These streams flow with gentle grades through wide valleys covered with the flood-plain deposits of earlier periods. Consequently the spring freshets result in floods that spread over a considerable territory unless controlled by levees. Calculations have been made of the rate of erosion of various rivers. Using the figures of the Po, in Italy, where conditions approach most nearly those of the Sacramento, it has been estimated that the sediment carried by the latter which is derived from the natural erosion of its own channel and its tributaries varies from 5,600,000 to 43,000,000 cu. yd. per year. The problem was serious enough in itself without adding to this amount the vast quantities of debris resulting from the placer operations, which in many cases had grown to enormous size and had involved large amounts of money in permanent works.

The accompanying photograph shows part of the pit of the Malakoff mine at North Bloomfield, in Nevada county, the largest placer mine of all time and one from which some of the most valuable data on hydraulic mining have been obtained. One can get some idea of the debris of this one mine by realizing that its banks reached a maximum height of 265 ft., water was used under a head of 800 ft., a static pressure of 347.2 lb. per square inch, and directed against the banks through nozzles with diameters up to 8 inches. In 1877 the Malakoff used 595,000 miner's 24-hour inches and moved 2,993,930 cu. yd. of gravel. From 1870 to 1877 inclusive it moved 11,-021,630 cu. yd. of gravel.

Various figures have been given as to the duty of water in hydraulic mining, all of which vary widely, the chief factors being the character of the material and the size and grade of the sluices. At the Malakoff it varied from 18 to 21 cu. yd. of water for each yard of gravel. Harts* places the average duty at the mines on the Sacramento watershed at three cubic yards per miner's 24-hour inch, equal to 26.66 cu. yd. water per yard of gravel moved. These figures are quoted to give some idea of the immense amounts of debris washed from the watersheds of the rivers mentioned. It must be remembered that when hydraulic mining was in its prime practically the entire flow of the mountain streams was put to this use.

The State Engineer of California estimated that in 1880 53,400,000 cu. yd. of sediment and gravel found its way into the Sacramento basin. 18,100,000 cu. yd., of which 4,900,000 cu. yd. was the result of natural erosion,

*For most of the data concerning erosion and the debris deposited I am indebted to 'Control of Hydraulic Mining in California by the Federal Government' by W. W. Harts, Trans. Am. Soc. C. E., Vol. 57.

was brought down in suspension; of this 2,100,000 cu. yd. settled in the overflowed basins and 16,000,000 cu. yd. was deposited along the channel or carried into the bays of Suisun and San Francisco. From 1849 to 1880 the low-water plane of the Sacramento was raised 7½ ft., tides at the city of Sacramento almost disappeared, navigation was seriously impeded, and it was estimated that this stream contained 108,000,000 cu. yd. of placer debris.

Conditions on the San Joaquin river were similar, but it is probable that the Yuba, to which the largest operations including the Malakoff, were tributary, was the greatest sufferer. It was estimated that the Lower Yuba contained 333,000,000 cu. yd. of debris and the low-water plane at Marysville was raised 15 ft., making necessary the construction of an extensive system of levees to protect adjacent lands from inundation.

Obviously such a condition was intolerable to the agriculturists, whose lands were frequently overflowed and covered with fine tailing, and to those who had invested money in river-transportation enterprises. Various legal actions were started. After some years of litigation the year 1880 found hydraulic mining on the watersheds of the Sacramento and San Joaquin rivers practically stopped by injunctions obtained in the local and Federal courts.

At this point the matter was made the subject of investigation by Congress, and this investigation was carried on for eight years, from 1880 to 1888, finally resulting in 1893 in the passage of the Caminetti Act. This Act was ostensibly designed to protect the navigable rivers, but its provisions were such that it also has the effect of protecting the agricultural lands, as only those mines were allowed to operate that could do so without discharging their debris into the navigable streams. At first thought this might appear to be an assumption by Congress of authority over State affairs, for the trouble was confined to two river-basins in the state of California, but it is based on the constitutional authority of Congress to exercise jurisdiction over navigable rivers and interstate commerce. The validity of the Act has not been questioned; in fact, the miners welcomed any move that might permit even a few of them to operate.

The Act created the California Debris Commission, a Federal board of three members from the Engineer Corps of the U. S. Army, with authority to pass on all schemes for the impounding or controlling of debris from hydraulic mining operations with power to stop any that do not meet with its approval. Thus the effect of the Act is to permit such mines to operate as will install works adequate to control their tailing and prevent it from reaching the navigable streams of the valleys. The authority of the Commission is limited to the watersheds of the Sacramento and San Joaquin rivers, and its duties also include investigations and formulation of plans to improve the navigability of these streams in their lower reaches.

The Commission has worked with a broad-minded spirit, the result being that many hydraulic mines have been able to resume operations, while there has been a gradual improvement in the condition of the lower river-channels. The choice of a dam is wholly within the discretion of the operator, the only conditions being that it shall be efficient and safe. Many types have been used, notably stone, earth, brush and rock, and log cribbed with rock-filling. Some concrete dams have been built but in general they are too expensive for this purpose, so that the log cribbed with rock-fill is probably the most common. A debris dam, however, must combine efficiency and safety with economy. Most hydraulic mining is conducted on a narrow margin of profit and it has been found too often that the dam designed to meet the requirements of the Debris Commission added so much to the expense of operations as to make it unprofitable. For this reason the dam now under construction to impound the tailing of the Omega mine in Nevada county is of interest, as it has met the requirements of the Commission and has been constructed at a very small expense per yard of gravel hydraulicked.

The Omega hydraulic mine is situated on the channel of the Tertiary Yuba river about 3½ miles above Washington, California, an old settlement dating back to the very earliest days of the great stampede. It is perhaps fitting that the dam to be described, the first of its kind, should be built within a short distance of the spot where the clever Yankee first turned his water through the rawhide hose with its cow's horn nozzle.

The tailing from the Omega mine discharges into Scotchman creek. The first dam was built about 2½ miles below the mine and about a quarter of a mile above the South Fork of the Yuba river at a point where the creek cuts a narrow channel through the slate that forms a part of the Blue Canyon member of the Calaveras formation. This dam is made of concrete, 23 ft. long at the bottom, 55 ft. long at the top, 15 ft. thick on top with a down-stream face 45 ft. high. The reservoir formed thereby was of small capacity, so that it was soon filled, and as the length increased rapidly with the height the economic limit of such a dam was soon reached.

After a period of idleness the mine resumed operations and construction was commenced of what, for lack of a better name, may be called a 'basket' dam. The old concrete dam was used for the toe of the new dam and the tailing back of it was excavated to a depth of two feet. In the excavation, two tiers of baskets were laid butting against the old dam. The basket dam was designed by J. M. Howells, of San Francisco, who conceived the idea from the Japanese *jakago*, a levee facing of loose rock restrained by bamboos so constructed that if the facing is undermined by the current the rocks settle of themselves and cover the eroded spot.

Construction of the basket dam proceeded as follows: The baskets were made of ordinary poultry-netting of 14-gauge galvanized wire and 6-ft. widths. For a reason to be mentioned later the length of the baskets varies, eight feet being the average at the time these notes were made. Such a basket is made by cutting eight feet of poultry-netting and folding it over so as to bring the two bound

edges together on top and then wiring the meshes of the netting together on the ends. This can perhaps best be understood by folding a piece of paper as described. The result is a wire container that may be described as pillow-shaped with a seam opening lengthwise along the top and of such dimensions that when filled it will measure 8 by 2 by 1 feet.

In building the dam a two-inch plank is set on edge two feet from the bank, or from the last basket laid, and held in place by driving iron pins alongside. One of the empty baskets is set in the two-foot space thus formed and filled with small boulders, not larger than a man's head, with sand and gravel sprinkled into the interstices. The open edges of the netting are then brought together by means of a curved piece of strap-iron with a sharply curved hook on the end and held while they are tied together with wire. The down-stream ends of the baskets are lined to a wire stretched taut along the line to which they are to be built and the tops are brought to level with a straight-edge. A spillway 20 ft. long and 1 ft. deep is carried at one end of the dam. Each row of baskets is started with its down-stream face one-half its length back from the corresponding face of the basket on which it rests. Thus if 8-ft. baskets are used they will lap 4 ft. As the baskets are laid, gravel is filled behind them for 10 ft. so that the top width of the dam is 10 ft. *plus* the length of the basket, or an average at the Omega dam of 18 feet. The concrete dam was built at a point where the creek makes a sharp bend almost at a right angle, so that in carrying this dam up it has been necessary to curve it to conform with this bend, which gives it the fan shape shown in the photograph. On this account the length of the baskets has been varied, causing a corresponding variation of the slope of the down-stream face. At the time these notes were made the dam was 150 ft. long, including the spillway, and 35 ft. high, with a slope on the inner side of 2 : 1 and on the outer side of 6 : 1. The cross-section illustrates the average as it is at present, a 4 :1 slope using 8-ft. baskets. When the dam reaches a point on the stream where it is no longer necessary to carry the fan shape, 6-ft. baskets will be used with a lap of four feet giving a down-stream slope of two to one.

Conditions prevailing at the Omega site were not favorable to the lowest cost of operation. The ideal condition would be one that would allow of backfilling with a hydraulic giant, but this was not possible. Dragline excavators were tried, but it was found that under present conditions they are not feasible. They can be operated in another season. It was therefore found necessary to excavate with pick and shovel and move the dirt by wheeling. Fortunately there is plenty of gravel at each end of the dam, so that even with this method the cost is not excessive.

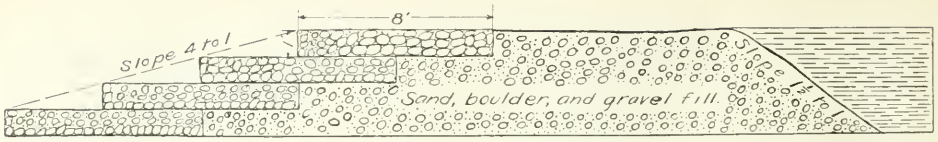
When the mine is discharging 1000 cu. yd. of tailing per day, the debris can be controlled by 2 men laying baskets and 4 men shoveling and wheeling. If wages are $3 per day, with a foreman at $4, this would bring the labor cost to $22 per day. This is the only expense except for poultry-netting and wear of the tools, which amounts to not over $5 per day, so that under present conditions the total cost is approximately 2.7c. per yard of gravel hydraulicked. However, as the height of the dam is increased the area of the pond increases rapidly in both length and breadth out of proportion to the increase necessary in the length of the dam as it is raised. For this reason it is expected that in another season the same amount of work and material now necessary to control 1000 cu. yd. of tailing will then impound approximately 4000 cu. yd., thus bringing the cost per yard of gravel hydraulicked to about 0.7 cent.

THE MALAKOFF GOLD-GRAVEL MINE.

The above crew can lay and back-fill 20 baskets per day. One basket (average at present) is 8 by 2 by 1 ft., so that the basket-work amounts to 320 cu. ft. per day. Back of the basket-work is 10 ft. of back-fill, 6 ft. of which is on the earth already filled in and thus only one foot deep while four feet must go down to the bottom of the pond, about 6 ft. on a 1½:1 slope, making a total for the 40 ft. of dam laid in a day of 1520 cu. ft. or 56.3 cu. yd. at a cost of 48c. per yard.

One of the regulations of the Debris Commission provides that the water in the pond must have a depth of at least 3 ft. below the level of the spillway at a point 150 ft. upstream from the dam. This regulation is wholly within the discretion of the Commission and may be altered one way or the other, as justified by the magnitude of the operations of the mine. It has been found that when it is met a depth of six feet of water is obtained at the dam.

The basic principle of this dam is the relief of pressure rather than resistance to it. The most impervious part is the back-fill, the up-stream face of which is continually covered with a layer of very fine silt, 'slickens' as



CROSS-SECTION OF THE DAM.

the placer-miner calls it. This silt makes the dam practically water-tight, but such water as does seep through makes its passage into the back-fill and spreads out in the many tiny open spaces therein or perhaps finds it way to the baskets. These are purposely made porous, so that the water which reaches them does not have a chance to accumulate and gain a pressure such as might eventually cause a failure of the structure, but gradually seeps through without resistance and discharges from the face of the dam under no pressure at all.

The step nature of the structure is also designed to offer a protection against erosion from floods. It will be noticed that every point on the face is protected by the thickness of two baskets. If a flood pours over the crest of the dam it is broken into a series of cascades, each one with only a drop of one foot and falling on two feet of the rock-filled baskets, so that obviously the damage from such a source would be slight.

In the spring of 1915 the dam was subjected to a severe and unexpected test of this sort when an unusually heavy and long-protracted season of rain brought a sudden flood down Scotchman creek. This poured over the crest of the dam continuously for five weeks. The flood was so unexpected that several broken boulders with sharp edges were left by the workmen on the crest of the dam. These were carried down the face in the first rush of the water and cut the wires of two baskets allowing, some of the filling to be washed out. It was five weeks before this damage could be examined and it was then found that the baskets above had weighed the others down and closed the opening formed by the escape of the filling so that no more boulders could work out, the displacement being distributed gradually through the other baskets, leaving the dam perfectly safe. It is here that the principle of the *jakago* comes into play, as it will also in case of the natural settling that may be expected of such a structure. But it is evident that it is impossible for any boulder of a size sufficient to injure the face of the dam to pass down the stream and through the several hundred feet of still water in the pond to the dam itself by any flood, however great.

The designer of this dam states that it is not the intention to expect it to act as a spillway for flood-waters except as may be occasionally required while the mine is in operation, and the dam itself is under the close oversight of those engaged in its construction. The Debris Commission requires that all dams not made of concrete shall be so constructed with a permanent bedrock or concrete spillway as forever to divert the flood-waters in such a manner as to guarantee the continuous storage of the tailing. The spillway required is proportioned to the precipitation and the area of the watershed, with a large factor of safety. In the case of the Omega it will be cut through the slate bedrock and will have a capacity of 2000 sec. ft., a factor of safety of 10, as the drainage-area of Scotchman creek is small and it is not expected that its discharge will ever exceed 200 second-feet.

This will prevent any water from being carried over the dam, which has not been designed with the idea that it will act as a permanent spillway. However, there seems to be reason to believe that the dam would be satisfactory even if put to this test. At first thought it might seem that its usefulness would be limited by the life of the baskets, that when the wires rust the baskets will fail, and the structure gradually disintegrate. But on further consideration it is reasonable to suppose that the constant percolation of silt-laden water through this basket-work will have a tendency to cement the loose gravel and boulders. It has also been found that the water which comes down from the mine carries a considerable amount of iron oxide, one of the commonest of nature's cements, in solution. This iron oxide is deposited from the water and one can observe this process of cementing going on to a limited extent at present.

That this dam is performing the service for which it was designed is evident from the fact that not only the tailing from the mine but the natural sediment of the creek is impounded. The water discharged actually contains less sediment than it did when the mine was not operating and there was no dam. I am indebted to J. M. Howells, C. E., of San Francisco, designer of the dam, for assistance in collecting and preparing these notes.

A PLACER is an unconsolidated deposit accumulated by mechanical processes, carrying one or more minerals in commercial quantities. All placers are secondary deposits; that is, the material of which they are composed was originally derived by erosion of bedrock. Although it is undoubtedly true that under certain conditions nuggets of placer gold have been enlarged through chemical precipitation, yet this action is a negligible quantity in placers. Placers may be derived solely by rock weathering without water sorting, but more commonly are the result of water transportation, sorting, and deposition. Many of the richest placers are those formed by the erosion of older placers and the re-concentration of their gold.

COSTS at the Mt. Lyell copper mine, Tasmania, during the six months ended March 31, 1915, totaled $6.86 per ton of ore smelted. This included the mine, smelter, railway, office, and depreciation.

Questions on Milling Practice

By A. O. GATES

Suppose we pile up pieces of crushed rock as shown in Fig. 1 and then strike *A* a good stiff blow. What happens to the various pieces? Which is damaged the worst, the big fellow or the little fellows?

And if *A* did not break on the first blow but passed it on, as big fellows usually do, when would he get his, if the licking continued? And what would be happening

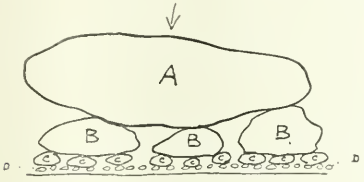


FIG. 1.

to *D* and *C* and *B*? This has nothing to do with the War.

Suppose in Fig. 2, *xy* represents the screen-analysis of the product from a crushing machine, and *xz* the product after an 'improvement' is made, either in the lining, the screen arrangement, the crushing medium, or in the type of mill; the ratio tonnage to horse-power being unchanged, has anything been gained? Do you get any better extraction from the + 60 mesh material than before? Whether it be washing-after-leaching, concentration, or flotation, do you get any better results out of the – 200 mesh material?

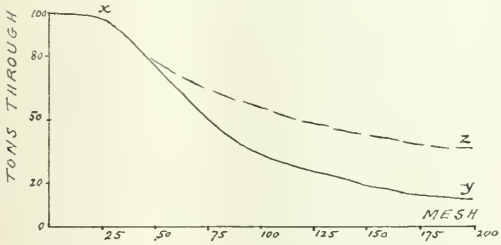


FIG. 2.

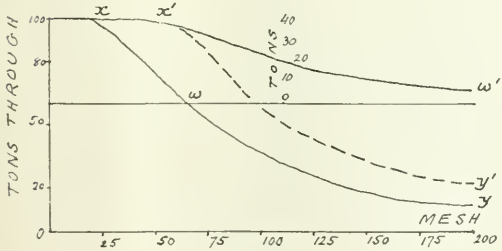


FIG. 3.

In your opinion would *xz* require more power?

Now suppose we again have the screen-analysis *xy* in Fig. 3, and we split it up into two lots *xw* and *wy*; we re-crush the coarser material *xw* to an analysis *x'w'*, which combined with *wy* gives the screen-analysis *x'y'*; how about the probable extraction on the 40 tons of coarser material corresponding to the + 60 mesh in Fig. 2?

Suppose the quantities of – 200 mesh at *z* in Fig. 2 and at *y'* in Fig. 3 are equal, which will probably have the larger quantity of – 1000 mesh? And which will offer the greater difficulty in concentration, flotation, or washing: the pulp with the greater percentage of – 1000 mesh, or the pulp with the less?

If the same horse-power per ton is required in producing *x'y'* in Fig. 3 as in producing *xz* in Fig. 2, which product is the more desirable metallurgically?

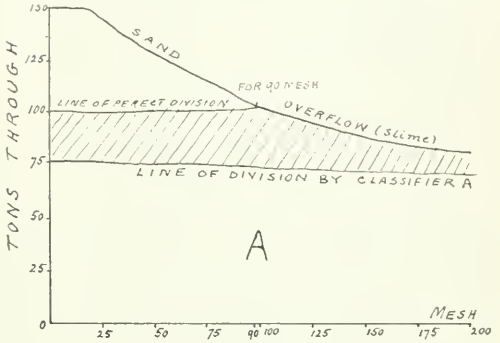


FIG. 4.

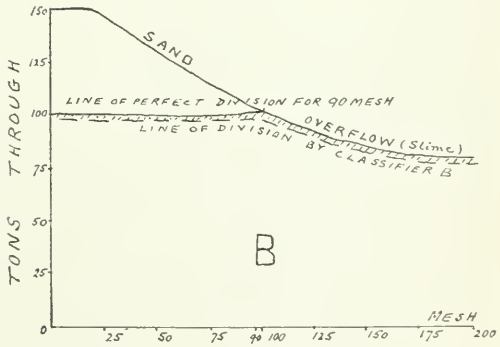


FIG. 5.

Is it good metallurgy to decrease the amount of – 1000 mesh and to increase the amount of – 100 mesh, that is, making the line of screen analysis steeper? If Rittinger be right, so that it takes ten times as much energy to produce – 1000 mesh material as it takes to produce an equal amount of – 100 mesh material, would the steepening of the screen-analysis line save any power?

One thing more and then I'll stop. Do screen-analyses, expressed in percentages placed side by side, give a clear conception of the difference in the operations? Take this example of two classifiers side by side, handling the

same tonnage of feed, moisture being around 5½ to 1.

		A		B	
	Feed.	Sand.	Overflow.	Sand.	Overflow.
Tons per 24 hr.	150	75	75	52	98
	%	%	%	%	%
+ 20	1	2	..	1.5	..
+ 40	13	27	..	37	..
+ 60	23	56	1	67	0.5
+ 100	35	69	5.5	92	2.5
+ 200	47	84	10	94	21
— 200	53	16	90	6	79

A has 90% of −200 mesh in the overflow while *B* has 79%.

But when you diagram it on the basis of a separation at 90-mesh there is a different look to it. The cross-sectional area, Fig. 4 and 5, represents the *surface* that got into the wrong place.

After you have answered all the questions you may go back to work.

Colloidal Chemistry

By CLIFFORD RICHARDSON

*Colloidal chemistry originated in the investigations of Graham in the sixties of the last century. It then lay dormant for forty years and has only recently been developed to an extent commensurate with the importance which it is now recognized as having. The original idea of Graham was that substances could be classified as crystalline and colloidal, with a sharp line of division between the two, according to whether or not they would, in solution, diffuse through an animal or semi-permeable membrane.

It is now recognized that colloids are merely a state of matter, one in a highly dispersed or subdivided condition. By appropriate means, in a suitable medium or phase with which the substance does not form a molecular solution, crystalline substances can be obtained in such a degree of subdivision or dispersion that they exist in a colloidal state, that is, they will remain suspended in a medium indefinitely. The chemistry of colloid matter then differs from the chemistry of matter in its ordinary form, merely by the degree of its subdivision or dispersion. In order to be dispersed in colloidal form a substance must exist in a system of at least two phases; an interior or disperse one which may be solid or liquid, and an exterior or continuous phase in which it is dispersed. The main characteristic of the disperse phase is its state of subdivision or degree of dispersion. Bancroft has characterized this as follows:†

"If we drop a stone into water, it sinks very rapidly; if we grind the stone into coarse particles these sink less rapidly; if we grind the stone into fine particles, these sink slowly; if we grind the stone into very fine particles we should expect them to sink very slowly, the rate being a function of the diameter of the particles. This is not the case, however. Very fine particles do not follow Stokes' equation and do not settle at all, because of the Brownian movements which are negligible for coarse particles. We, therefore, conclude that any substance can be brought into a state of colloidal solution provided we make the particles of that phase so small that the Brownian movements will keep the particles suspended, and provided we prevent agglomeration of the particles by a suitable surface film."

The Brownian motion to which Bancroft refers is one which can be discerned under an instrument known as the ultra-microscope which makes visible particles which are invisible in the ordinary instrument. It serves as a means of detecting matter in a colloid state which has been unavailable except within the last decade. The size of particles, when in a colloid state, is ordinarily as small or smaller than 0.0001 mm. in diameter, and in the case of some solids no larger than 0.000006 millimetre.

A realization of the enormous surface area possessed by disperse solid colloids of this size may be arrived at from the fact that if an amount of material represented by a cube, one side of which has a dimension of one centimetre, is reduced by decimal subdivision only to the coarsest colloidal size, a ten-thousandth of a millimetre in dimension, the number of cubes produced would be 10 to the 15th power, while the surface area would be increased to 60 square metres, or 100,000 times that of the original cube. The great increase in surface area of the finer material over that exhibited by the surface area of a single cube is at once made evident. Surface energy is demonstrated by the fact that if two plates of glass, which are ground perfectly parallel, be brought together with or without water, it is difficult to separate them, owing to the surface energy of the film of air or water which is imposed between them, energy far greater than can be attributed, as has been asserted, to the pressure of the atmosphere. This same phenomenon is exhibited in cementing together with bitumen the particles of a mineral aggregate of a sheet asphalt pavement, having a great surface area.

Adsorption is the power a solid or liquid surface has of holding thereon a thin film of solids, liquids or gases, an example of which is the film of air or water which is found under ordinary conditions on the surface of glass. Colloids possess this property to a high degree, owing to the large surface area they present. Adsorption is well illustrated by the manner in which a dye or coloring matter is removed from its solutions by a substance like charcoal or kaolin: this is known as selective adsorption.

[A good example of selective adsorption is the presence of iodine in seaweed. The iodine salts are selectively adsorbed, by the colloidal substance of the seaweed, from the sea-water, though the amount of iodine in sea-water is so small that it cannot be detected. This property of adsorption is of importance in many metallurgical operations, now that the practice has become general of grinding ores to an extremely fine state of subdivision in order to free the included mineral. With this fine grinding, the particles of ore tend to approach the colloid stage and if valuable chemicals are employed the tailing may carry away considerable quantities that cannot be recovered by any practicable amount of washing.]

*Excerpt from *Jour. Industrial and Eng. Chemistry.*

†*Jour. Phys. Chem.*, 18, p. 549.

Notes From South America

By MARK R. LAMB

Chuquicamata was formally started by his Excellency the President of Chile. The papers were full of favorable notices of the event and the company and Americans in general. One paper gave a particularly lucid statement of the advantages resulting in favor of Chile from this big enterprise, and expressed the wish that there were fifty such here. An analysis of the expenditures of the company showed clearly the amounts spent for labor and local supplies, and the article will go far to remove the last remaining traces of hard feeling against the concerns that are shipping such large quantities of mineral from the country.

After a shut-down of several months, the Guayacan smelter is to start again on a very moderate scale, shipping matte as heretofore, but in much smaller quantity. A small company is being formed to supply funds for starting, and it is expected that it will be possible to make more than expenses from the start.

The Calama company is in better financial condition than for many years. The mines are shipping a good quantity of sorted ore, and the little old smelter at Calama is making several tons of bar copper per month. The company is capitalized at $800,000, so that the dividends will be spread out rather thin. With present prices of copper, the management is making every effort to increase production.

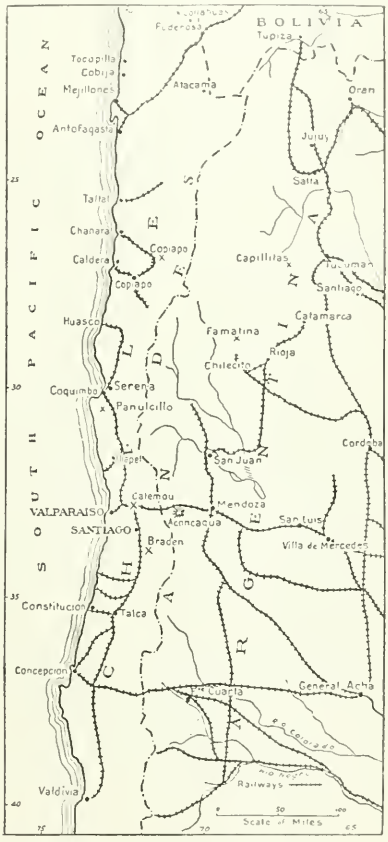
Sr. Felipe Herrera is producing regularly about 30 ounces of gold per day with his Tremain stamp-mill. His success has induced other owners of small gold mines to erect small plants. A Tremain is going in to Petorca this coming week and will crush ores from the Durazno mine. Another small mill is being erected in La Ligua. This plant is one of the last things to arrive in Chile from Germany.

The Murex people have a fine working-scale testing-plant at Santiago and are making numerous tests of copper, silver, tin, and gold ores. As Chile is profusely supplied with iron ore, it would be difficult to find a place where the necessary magnetite was not right at hand. And as the country is narrow, supplies of oil and fuel are usually easily obtainable. A large waste-dump of copper ore at Batuco is to be treated by the Murex process, and negotiations are under way for a plant for the Espino mine, near Pedegua.

The condition of the nitrate market is far from satisfactory, the price ruling today close to $25 per ton, export-duty paid, and on board ship. This is far below the ruling price before the War, and it is to be expected that California fruit-growers will take advantage of the low prices. Although the shipments of nitrate are sure to be less on account of Italy going into the fight, a number of nitrate plants are planning to begin operations again, and this in the face of a heavy drop in the leading nitrate shares.

The jump in prices of zinc and quicksilver has started work on several mines yielding these metals. One district called Punitaqui was for many years a producer of quicksilver, but has been closed-down for forty years. An energetic group has re-located the district and firebrick is already on the way to the mine for the construction of the furnaces. Practically no machinery will be required, as the deposit is so large that no underground work is necessary for a long time. There are inquiries for quicksilver from Europe, which would indicate that the metal is used in some way in shooting people.

There are a number of small mines that can produce



zinc ore, and one near Los Vilos has 100 tons of high-grade hand-sorted ore at the port for shipment.

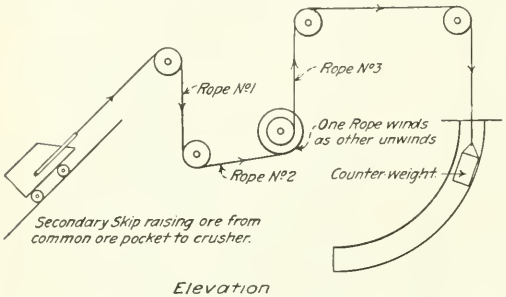
Freight-rates on ores have doubled, and in some cases are three times former rates. This makes difficulties for the producers, but not in proportion to the increased prices, so that mining is now actually on a better basis than before.

In view of the excessive prices asked for coke, careful tests have been begun to attempt the manufacture of coke from native Chilean coal. Practically all the coals here are Tertiary and do not therefore compare with the highest grades found elsewhere. Nevertheless, it should be possible to make a coke sufficiently strong to bear the burdens in the small furnaces used.

Mechanical Features at a Lake Superior Iron Mine

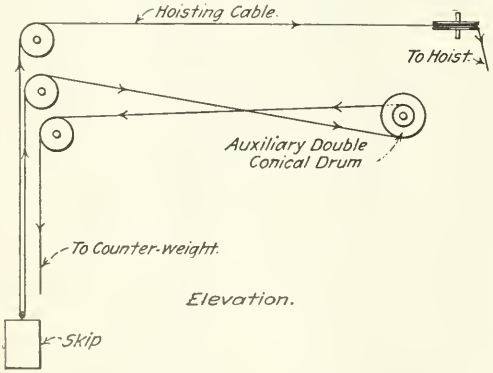
By P. B. McDONALD

Mines have individuality reflecting the personal abilities and shortcomings of their superintendents and engineers. Thus one property will be exceptionally well handled underground, with possibly its clerical work notably neglected, in which case it will be apt to attract good miners, but will impress visitors as being rather



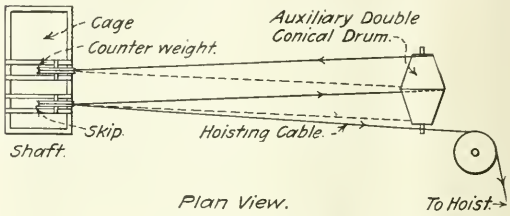
Elevation

slipshod. Another mine will emphasize its mechanical features, due perhaps to the ingenuity and talents of one of its engineers with a bent in that direction. The Republic Iron mine on the western Marquette range, Michigan, lately sold by the Cambria Steel Co. to the Cleveland-Cliffs Iron Co., is a mine of the latter class. It is a high-grade ore producer, mining a hard specular hematite, requiring good miners. Being the only mine



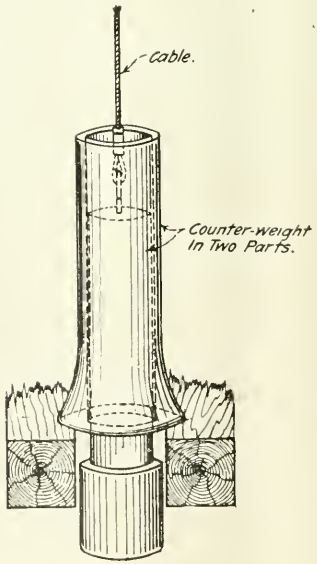
in the vicinity, it has attracted a desirable class of workers to the village of Republic, and has maintained excellent relations with its employees. Due to the mine being opened in the early days, and to an irregular shaped ore deposit, the original arrangement of the equipment and shafts were not as would have been planned if the development had been foreseen. Thus, when an engineer with mechanical ability took charge some years ago, there was a chance to improve matters.

The mine now has various mechanical features showing the result of his work. One of them is a stock-pile or trestle car for use in making an ore-dump starting along a side hill, with an arrangement for dumping only on one side. This car is entirely of steel; it has a long low truck with eight small wheels, and the ore or



rock is contained in a box of triangular cross-section that can only dump to one side.

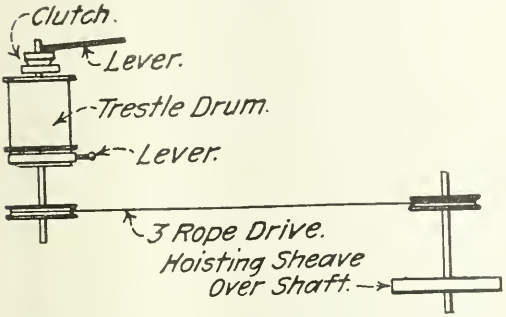
Another peculiar arrangement is the counterweight at one of the ore-hoisting shafts. This shaft is vertical and



is mostly for hoisting from depths of from 500 to 1000 ft.; it has only one compartment for a skip, which is therefore balanced by a counterweight.

In addition to the regular hoisting-cable fastened to the skip is a second cable that passes over a small sheave and to a double conical drum. From the drum it passes over another small sheave to the counterweight. The drum, being conical, helps to accelerate the load at the start of hoisting. When the skip is dumping, the load

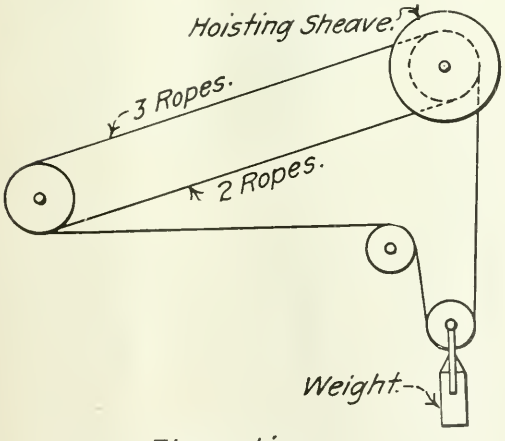
is not so great as only one end of the skip is being raised; to take off some of the weight of the counterweight at that time, it is made in two parts, the outer of which is lifted off by timbers at the bottom of the shaft as seen in the sketch. Later the outer counterweight is raised by a shoulder on the inner counterweight. It may be stated



Plan View.

in passing, that some Lake Superior mines are counterweighting their man-cages by a long 11 in. steel cylinder or shafting that moves in a 12 in. iron pipe, making a compact and space-saving counterweight with no danger of anyone getting caught by it.

Stock-pile or trestle cars at the Republic mine are run out by gravity, the trestle being inclined for that pur-



Elevation.

pose, and a clutch on the trestle-drum being thrown out to allow it to revolve freely. The car is pulled in as follows: On the same shaft as is the hoisting-sheave is a smaller sheave, which, by a rope-drive, runs the small drum on the trestle. As the regular hoisting-sheave revolves, the car is pulled in.

Another unusual feature is the economy secured in crushing ore and sub-hoisting ore to the crusher, using one engine alternately for these two purposes. It is usual at many hard-ore mines to dump ore from the skip direct into a gyratory crusher, which rests on the ground on a concrete foundation, and then to hoist the crushed ore to a loading-pocket or to the stockpile-trestle by a secondary hoisting-engine, possibly one man tending the crusher and the secondary hoist. Some later installations at large mines have followed the copper country practice of only hoisting the ore once, dumping the skip direct into the crusher, but placing the crusher high enough from the ground so that cars can be loaded underneath. The iron mine operators have placed their heavy gyratory crushers on a separate foundation from the head-frame, as opposed to the copper country practice of placing a jaw-crusher in the shaft-house, where it shakes things a good deal. At the Republic mine one engine hoists ore from a common ore-pocket below the railroad track, and serving several shafts, to the crusher, and then furnishes the power to crush it. The sketch gives an idea of the arrangement, showing three separate ropes, and a counterweight that slides in a curved path.

Improvements at Anaconda

At the concentrator, No. 1 section, which was recently re-modeled to provide for the installation of oil flotation, is successfully treating ore at the rate of 2000 tons per day. The tailing assays well within the limits expected. No. 2 section is now being changed to provide for the use of a similar plant. Rapid progress is being made with the work. It is expected that tearing out the old machinery and constructing the new 2000-ton unit, ready for operation, will be accomplished in 33 days.

All four furnaces in the east reverberatory building are now operating on pulverized coal. Three of them are 143 ft. long; the fourth, which was the first furnace to be equipped for coal-dust firing, is 124 ft. long. These four are working well. They are smelting a greater amount of material than the eight grate-fired furnaces formerly did. All furnaces in the west building are now being re-built. They will be ready for operation when the No. 2 roaster plant is completed. In the coal pulverizer plant the pulverizer building is now completed. Work is progressing on the installation of the remainder of the crushing, storage, and drying equipment.—*The Anode.*

METALS produced by the Mt. Lyell properties, Tasmania, from August 1903 to March 1915 are as follows: copper, 194,261,760 lb.; gold, 175,627 oz.; and silver, 6,979,567 oz., from treatment of 4,193,789 tons of ore. Including production prior to that date the total is 303,074,240 lb. copper, 331,379 oz. gold, and 11,100,968 oz. silver. Dividends total $12,973,000.

GOLD PRODUCTION of Peru in 1914 totaled 670 kg., equal to 21,400 oz., from 12 departments of the republic. This bullion was sent to the mint at Lima, which executed coinage valued at Lp. 123,763, or about $594,062. The largest gold producers are the Cotabambas Auraria, Chuquitambo, and Aurifera Anadray Pasco. Their total was 417 kilograms.

Mining in California

By CHARLES G. YALE

*There are few changes to be noted in the mining industry in California for the first six months of the year, as compared with the conditions in 1914. Some gain in gold yield is apparent, however, the United States Mint at San Francisco, and local smelters and refiners having received $598,822 more California gold in the first five months of 1915, than in the corresponding period of 1914.

There was plenty of water available for mining in the winter of 1914-15, not only for gravel but for quartz miners, so that the working season for hydraulic mining has been longer this year than usual. The placer miners throughout the State took advantage of the abundance of water in the spring and summer months; and at numerous points, where little had been done for years, considerable gold was taken out. Drift mining continues inactive, with no new developments of note except that at the old hydraulic camps of Dutch Flat, in Placer county, long idle, the Federal Drift Mining Co. has discovered rich gravel in driving a tunnel connecting with the old Rough and Ready workings.

Dredge mining continues to be prosperous and productive. Some few changes have taken place in the movement of the dredges. The United States Dredging Co., which has its machine on Middle creek, three miles from Redding, and some other companies are prospecting ground in the vicinity of Igo, Gas Point, and in Happy Valley, in Shasta county. The Pacific Gold Dredge Co. has started a new dredge in Butte Creek district, six miles from Chico.

The Oro Water, Light & Power Co. has completed a dredge on the Mokelumne river, near Clements. Part of the machinery from the old Empire dredge was used in this. The Yuba Consolidated Goldfields is building a new 16-cu. ft. dredge with steel hull at a cost of $400,000. It may be said that the dredging companies that bought a lot of land along the Yuba river have stopped the old placer miners from working along that river. The Shasta Dredging Co.'s dredge, which has been operating at Horsetown, on Clear creek, has been moved 12 miles to a point near Gas Point.

In connection with quartz mining, it may be said that there has been very slight change. An unfortunate setback is that of the pending apex conflict between the Empire and the North Star companies, at Grass Valley, the two largest deep producers in the State. There are contentions of trespass, which arbitration has failed to settle, and now the matter is to come before the courts.

The North Star has constructed a large steel frame at the Central shaft and a new hoist to operate to a depth of 7500 ft. The Empire Mining Co. has erected a new mill of 60 stamps with a capacity of 300 tons per day. In conjunction with a 20-stamp mill operated on the Pennsylvania, the Empire now has 80 stamps at work.

*Report made to the Director of the U. S. Geological Survey.

The Bunker Hill Co., operating near Amador City, has increased its output by adding a Hardinge mill.

The Plymouth, in Amador county, re-opened in 1914, has had a prosperous year and is now considered one of the best producers in the State. The South Eureka continues to run its 80-stamp mill and the Central Eureka is becoming prosperous. Work has been started on the Providence shaft of the Champion mines at Nevada City, and the shaft, which is 800 ft. deep, is being repaired, and a new frame and hoist is being erected.

The Standard mine at Bodie, in Mono county, has

passed into the hands of J. S. Cain, owner of the South End group.

In regard to copper mining, the conditions at present are much better than they were last year. The Mammoth Copper Co., in Shasta county, is now running to its full capacity. The concentrating plant of the Mountain Copper Co., near Keswick, has been completed and put in use, and the smelter on San Francisco bay has again been blown in. At the Dairy Farm mine, in Placer county, a railroad nine miles long, to carry the ore to Sheridan, has been completed. The Balaklala Copper Co., in Shasta county, has repaired the tramway and other surface structures and the property is being put in shape for a heavy output as soon as arrangements for ore reduction have been perfected. This ore will probably be shipped to the Mason Valley smelter or the Tacoma smelter, and the output is expected to be 500,000 lb. of copper monthly.

The Calaveras Copper Co. has put in an oil-flotation plant at its big copper mine. The old Copper King mine, near Fresno, will shortly be started, it is probable, and it is expected that it will turn out a thousand tons of 3% ore monthly.

The Wah Chang Mines, China

By H. T. LIANG

History. The Wah Chang Mining & Smelting Co. was organized in the 34th year of Kwang Hsü (1908) and a patent to its smelting process was given by the Chinese government. Therefore no person or company can use the same process for antimony ore anywhere in China and no antimony-smelting company is allowed to incorporate in Hunan province for 10 years following 1908, no matter what processes it plans to use. In 1908 this property and the Kiu Tung antimony mine were consolidated. Previous to 1908 the Kiu Tung antimony mine smelted its stibnite ore into crude antimony by native methods. After the consolidation the ore was treated by the volatilization (Herrenschmidt) process.

The Wah Chang smelter is situated near the Si-Hu bridge, at Changsha, in Hunan province. The Kiu Tung mine is at Pan-chi, 46 miles from the Yi-yang district and about 100 miles from Changsha.

Geology. The country rocks near Pan-chi are old crystalline slates, broken through at several places by granite. The intrusion of the eruptive magma in part has tilted the old slate rocks at high angles and elsewhere has given rise to lateral displacements. These phenomena are to be seen in the valleys formed by erosion.

The absence of fossils in the slates and eruptive rocks renders difficult the determining of the age of the rocks and of the time at which the ore deposit at Pan-chi was formed. Only by analogy with the geological formations of the antimony deposits in such remote districts as An-hua and Sin-hua is it possible to estimate the geologic age. It is probably Paleozoic. In the ore deposits at Pan-chi it is important to note that no lateral displacement but only tilting of the slate is to be observed. The dip of the strata is steeply inclined or even vertical. Therefore, the veins of the Pan-chi mine are likely to persist in depth and disturbances in the regularity of the dip are much less likely to occur. Mining operations up to the present afford justification for this opinion, as down to the deepest level the orebody is of a uniform structure.

The lodes are of simple geologic structure. Presumably metalliferous solutions circulating in fractures formed by horizontal displacements, caused by the eruption of the granite, have undergone chemical reaction with other metals, such as iron, precipitating antimony sulphide in the fractures.

The antimony deposits of Hunan and Hupeh contain only small amounts of arsenic, as the following quotation from an article by W. R. Schoeller in the *Journal* of the Society of Chemical Industry indicates. "The Siang-kiang would appear to form the eastern boundary of the antimony belt. The district situated between that river and the Yuen-kiang and of which the city of Sin-hao may be said to be the centre, produces the purest and richest stibnite ore, a typical ore assaying 57.64% Sb and 0.127% As, with traces of Pb and Cu. However, the arsenic is usually well below 0.1%. The gangue amounts to about 15% and consists of quartz, occasionally mixed with schistose rock. The mineral is most frequently coarsely crystalline, showing long stout prisms of strong lustre. Massive stibnite is not uncommon, and the richest ores are of this variety with an antimony content of 60 to 65%. To the north of the Sin-hao district the de-

PART OF HUNAN PROVINCE.

posits become poorer; near An-hao there occur ores averaging 48% Sb, with 0.06% As and negligible quantities of lead, copper, and zinc. They are granular texture and present a dull lead-gray appearance. Low-grade ores are also known to occur. A 25% ore showed beautiful isolated crystals several inches long, embedded in a slaty gangue. Another ore (28.94% Sb) of extraordinary hardness consists of an intimate mixture of quartz and stibnite in fine-grained masses. Both ores were practically free from arsenic. Passing into southwestern Hupeh the ore deposits show an increased proportion of arsenic, a sample giving 51.75% Sb and 0.43% As.

"The same may be said of stibnite and crude antimony from the provinces of Kwei-chow, some of which finds its

way down the Yuen-kiang. Specimens were examined with the following results:

1 Ore Sb 62.99%, As 0.846%, Cu Zn—trace
2 Crude Sb 69.85%, As 0.46%
As 0.303%"

METALLURGY. The company smelts its stibnite ore by a simple volatilization process. The composition of the ore from the Pan-chi (Yi-yang district) is as follows:

a.	Antimony 32%	Sulphur 11%	Silica 44%	
	Iron 12.85%	Arsenic 0.5%		
b.	Antimony 25%	Sulphur 10%	Silica 53%	
	Iron 11.8%	Arsenic 2%		

The composition of antimony regulus, or the metal, is as follows:

1	Sb 99.760%,	As 0.090%
2	Sb 99.950%,	As 0.050%

The metals produced by the Wah Chang Company have been carefully analyzed by W. A. Cowan, who published his results in the *Transactions* of the American Institute of Metals, Vol. VIII, 1914. It is important to note that the Wah Chang metal is purer than either the Cookson's 'C' brand or Hallett's 'H' brand.

"The samples of antimony were obtained in a similar way, by taking individual ingots from lots bought in the market of the following brands: Cookson's, branded 'C'; Hallett's, branded 'H'; Japanese, branded 'M C'; Chinese, branded 'W. C. C.' with two overlapping circles 'OO'. The Cookson's and Hallett's are both produced in England, probably largely from imported ore.

"The results represent respectively only the one ingot of each brand and not, necessarily, the average composition, except in so far as the manufacturer would guarantee each ingot to come within certain specifications. Neither should it be supposed that the composition of any of the brands represents the characteristic production of the country of its origin.

"The samples of antimony were prepared for analysis by breaking up the whole of each ingot, crushing, quartering, and powdering, finally putting two pounds of each sample through a 100-mesh sieve. They were then carefully mixed and divided into portions for the different analyses.

"The determinations reported here show also the need of much more work being done. The results so far obtained are given in the table below:

METALLIC ANTIMONY ANALYSIS

	Cookson's 'C'		Hallett's 'H'	
	A	D	A	D
Lead	0.041	0.102	0.669	0.718
Tin	0.035	trace	0.175	0.012
Arsenic	trace	0.092	trace	0.210
Bismuth	.....	none	.....	none
Copper	0.040	0.046	0.038	0.046
Cadmium	.....	none	.....	none
Iron	0.010	0.004	0.014	0.007
Zinc	trace	0.034	trace	0.023
Nickel and cobalt	.....	0.028	.....	none
Sulphur	.....	0.086	.....	0.128
Antimony*	.....	99.608	.....	98.856
Total		100.000%		100.000%

	Japanese 'MC'		Chinese 'OO'	
	A	D	A	D
Lead	0.443	0.424	0.018	0.029
Tin	0.175	0.012	0.035	none
Arsenic	0.008	0.095	0.017	0.090
Bismuth	.....	none	.....	none
Copper	0.034	0.043	0.008	0.012
Cadmium	.....	none	.....	none
Iron	0.015	0.007	0.007	0.004
Zinc	trace	0.023	trace	0.027
Nickel and cobalt	.....	none	.....	trace
Sulphur	.....	0.201	.....	0.078
Antimony	.....	99.195	.....	99.760
Total		100.000%		100.000%

A—American Sheet & Tin Plate Company
D—National Lead Company
*—By difference."

MARKET CONDITIONS. The market for antimony is a peculiar one, as the prices are not according to the purity or grades, but their brands. The following statement was published in the MINING AND SCIENTIFIC PRESS on November 14, 1914: "Cookson's brands are more in demand than Hallett's and both command better prices than the Hungarian or Chinese antimony. The average price of Chinese brands is not available, but is usually about 1½ cents less than Cookson's. It is an interesting feature of this situation that careful analyses recently published by Mr. W. A. Cowan in the *Transactions* of the American Institute of Metals, show that although Cookson's antimony is purer than Hallett's, the Chinese Wah Chang antimony is purer than either. Recently Hallett's antimony has been most in demand, and the inference seems inevitable that antimony is sold on the basis of its trade-mark rather than its quality."

The Wah Chang and Kiu Tung companies were awarded the prize of the first class at the National Exhibition at Nangking, China, in the second year of Hsuen Tung, 1910.

THE DISTINCTION between agate and onyx is not apparent to everyone, as is indicated by the samples of the two minerals received by the U. S. Geological Survey with requests for information. Onyx marble, or Mexican onyx, is composed of calcium carbonate or banded limestone. True agate is a variety of silica. Onyx marble is much softer than agate and is rarely used for gems, but when onyx is obtained in pieces of sufficient size it is cut and polished for small ornamental objects like inkstands and paper weights, as well as for table tops and soda-water fountains.

MANGANESE production in the Caucasus district of Russia in 1914 totaled 652,354 tons, a decrease of 302,290 tons. In the first half of the year the output was 9.46% over that of the same period of 1913. The decrease for the full year was due to military operations.

OIL PRODUCTION of Illinois in 1914 totaled 21,919,749 bbl., worth $25,426,179. This is a decline of 1,974,150 bbl. Stocks at the end of the year were 13,563,743 barrels.

Mining in Colorado

By GEORGE J. BANCROFT

The effect of the European war on mining enterprises in Colorado is being felt more and more. On the whole, that effect is beneficial. The War has broadened the industry. It has made our mining men take notice of minerals heretofore passed over as of little account. It has further thrown us on our own resources. Promoters do not go "back East" to raise money any more. They get it close at home. Local capital is notoriously economical, and this again has had a good influence on operations. An important enterprise has recently been financed with local capital at Salida. The Peerless M. & M. Co. will re-open the famous old mine called the North Pole, situated above Salida on the boundary between the Chalk Creek and Monarch districts. The ore contains silver, lead, and zinc. The vein is 40 ft. wide in places. It has already been tapped at considerable depth by a cross-cut adit 1200 ft. long.

Another instance of local financing is seen in the success of John H. Nichols (recently general superintendent of the El Paso mines at Cripple Creek) in raising $100,000 in Colorado to re-open the old Freeland mine at Idaho Springs.

Shortly before the untimely death of Franklin Guiterman, of the American Smelting & Refining Co., he spent some time in Denver. He said to the writer: "The War has opened our eyes to our weaknesses and opportunities. We have for too long a time let the Germans handle the unusual and rare metals, in which there is small tonnage consumed but a very big profit. The volume of business in any one metal may be small, but take all the rare metals together and the business is altogether too big and too profitable for us to let foreigners take all the cream. I have been urging our company to erect works to handle the rare metals, and already we have made some progress in that direction." That Mr. Guiterman's wise and timely advice has not gone unheeded is shown by the activity in the Daly district, above Empire, where 100 men are busily engaged in mining molybdenum; in Boulder county, where the output of tungsten is rapidly increasing; in the remarkable strides made by the Golden porcelain works, their product supplanting German-made laboratory porcelain in many American laboratories; in the precious gem industry started by Prof. G. M. Butler in Fremont county, Colorado; and in the new titanium industry, which is gradually crystallizing into tangible form in southern Wyoming.

The past month has been one of great activity in the installation of mining equipment. The Mary McKinney at Cripple Creek has installed a large new electric compressor and hoist. The machinery for the new gold dredge for the Derry Ranch placer, on the Arkansas river, 12 miles south of Leadville, has arrived on the ground and is being erected on the boat. This dredge will be a material factor in increasing the gold output of Lake county. The Derry Ranch is a well proved placer, and the wonder is that a dredge was not built years ago. The explanation probably lies in the fact that the proved ground was somewhat limited in extent and so a great enterprise had to hang fire for several years pending the drilling of a few more test-holes.

The Western Colorado Power Co., at Telluride, has expended about $8000 in improvements and betterments. James McNeece of Leadville is re-modeling the shaft-house of the Fortune mine and installing a hoist. He has opened up the property from the Yak Tunnel and already proved the existence of profitable ore in the lower contacts. When the hoist is installed, he will clean out the stopes on the upper contacts and go after the zinc ore that was left behind years ago when zinc was a liability instead of an asset to the producer.

The Iron City mill at Black Hawk has been re-modeled and put in operation. The new cyanide mill of the Jerry Johnson, at Cripple Creek, is nearing completion. The Gordon Tiger property at Twin Lakes, Lake county, is working a small force of men preparatory to building a mill. The Idaho Bride M. & M. Co., near Idaho Springs, has completed the installation of a compressor plant, and development work is progressing in a satisfactory manner.

Among the notable discoveries of ore may be mentioned the high-grade gold ore in the Pro Patria adit at Rico. Rico is noted as a producer of silver, lead, and zinc. Gold, by itself, has never been suspected or sought after; hence the discovery of this ore, which had lain exposed on the tunnel-walls for many years, opens up the possibilities that there may be many bodies of similar ore in the district. The ore-shoot is reported as small but very rich. It is on a north-west and south-east vein, which series has always been considered barren. About $10,000 has been realized from ore-shipments to date.

The Kansas Leasing Co., working through the Argo Tunnel, has opened-up a nice body of ore in the Kansas vein, which was one of the famous early producers of Quartz Hill, Gilpin county. This strike is of unusual importance because it may lead to a general resumption of work in the Quartz Hill mines. Although this famous group, which has produced $50,000,000, was pierced at great depth by the Argo (or Newhouse) Tunnel several years ago, yet the water lowered very slowly and little ore was found in the adit.

Another epoch-making strike is that in the Ponsardin mine at Leadville. This is one of the mines affected by ex-Governor MacDonald's pumping coalition for the 'Down Town' mines. The discovery of a large body of zinc-lead ore in the Ponsardin, as the water lowered, has given additional enthusiasm to those who are backing the project.

At Cripple Creek "things never looked better," as one big operator tersely put it. Progress in that busy and complex camp is so varied that it is impossible to detail it in an article of acceptable length. In brief, new ore-bodies are being discovered at all depths. Working costs are being lowered. Old mines are being re-opened; notable among these is the famous old C. O. D. The Roosevelt drainage adit is daily tapping new water-courses and so lowering the water-level.

Non-Metallic Products

Compiled by SAMUEL H. DOLBEAR

Kaolin Refining at Ione, California

In the vicinity of Victorville, California, one of the first clay-washing plants in the state was erected several years ago. This attempt to produce a refined product for use in the arts was not entirely successful, although the material was used in the aint and other industries in southern California. One of the serious difficulties encountered at this plant arose through the fact that the buildings could not be made air-tight. Victorville is situated on the Mojave desert, where sand abounds and vegetation is scarce. In spite of all precautions, fine drifted sand found its way into the finished product, this grit rendering it useless for many purposes.

No such problem as this confronts the Products Development Co., at Ione, in its clay-refining plant, which has now been in operation for a year. In contrast to the arid conditions at Victorville, it has been found that winter rains have limited the operating season at Ione to about seven months each year. The refined clay, after treatment in the water-flotation plant, is distributed over drying-floors, solar evaporation being utilized to dry the product before shipment.

The refining of this clay is entirely a mechanical process in which the clay itself is separated from the sand embedded in it. This sand constitutes about 40% of the weight of the crude material, and is of particular interest on account of its high silica content. Analysis shows 99.5% SiO_2. It is one of the few sands found in California of sufficient purity to be used in glass-making. Experimental lots of several hundred pounds have been used for this purpose by San Francisco glass manufacturers and have been found as satisfactory as Belgian sand, which has been imported previously in large quantities. As the latter material is not to be had at this time, the Ione deposits have solved at least one local problem arising from the European war.

When mined from the bank, the clay is delivered to a cylindrical disintegrator. It then passes into the flume through which water moves slowly. The disintegration becomes complete in this flume, the sand readily settling and the finely divided clay remaining in suspension and passing into settling-tanks. There are three of these, each having a capacity of 20,000 gal. The clay settles gradually to the bottom of the tanks, and the water is decanted. Enough remains so that the product is now a thick sludge, this being pumped to a Kelly filter-press. When dry, the clay is pulverized in a cage-mill and is then ready for shipment. This plant is capable of producing 15 tons per day of refined kaolin.

The company is now building a second unit having a capacity of 25 tons per day of refined kaolin and 15 tons of sand. In this unit the clay will be treated dry and the separation made by a pneumatic process. A small experimental plant of this type was built in San Francisco before this new construction was undertaken, the experiments having indicated that the process was suitable for this work.

It is expected that the completion of this equipment will make possible operation at all seasons of the year. The product is used largely in the manufacture of enamel, sanitary ware, and to some extent by paint and linoleum manufacturers.

Borax

The production of borax in the United States has remained about normal during 1914. Depressed business conditions, it is true, have largely reduced local consumption, but the European war has disturbed production in other countries, and this deficiency has been partly supplied by the California mines, which are the only source in North America. Canada usually imports large quantities from England, but since the declaration of war has drawn upon American refiners for its requirements. The refiners of Austria and Germany have also been badly crippled, and the mines on the Sea of Marmora have been closed by the participation of Turkey in the War.

The world's commerce in borax and boron compounds is largely controlled by Borax Consolidated, an English company with headquarters in London. This company has refineries in England, France, and the United States, and has supplied the German and Austrian refiners with borate ore fro mits Chilean mines. The Turpish mines are, however, the older producers, and were worked years before the South American deposits were opened. The former have produced about 14,000 tons annually during recent years.

The California mines supply practically all of the borate ores used in this county. Three companies are engaged in this work, the largest of these being the Pacific Coast Borax Co. Since the sale of the F. M. Smith interests, this company has been controlled by the Borax Consolidated, with which it had a working arrangement prior to that time. The Pacific Coast company completed much construction work during the past year, including a branch railroad connecting its Biddy McCarthy and Monte Blanco deposits with the Tonopah & Tidewater railroad at Death Valley Junction, and a calcining plant at the Junction. In this plant the low-grade ore is roasted before shipment. The new railroad opens up some of the richest deposits in the Death Valley region, these being inaccessible heretofore owing to long overland hauls by wagon.

The Sterling Borax Co., with mines situated six miles fromLang, in Los Angeles county, is the second largest producer in California. A branch railroad connects these deposits with the Southern Pacific railroad. Dur-

ing the past year the company is reported to have mined about 15,000 tons of ore. This is divided into two classes: the first grade contains about 31% anhydrous boric acid, the second about 20%. All of the ore is roasted at the mine before shipment, thereby eliminating the impurities, which consist of clay, pandermite, and water. The colemanite content, upon being roasted is reduced to a fine powder, while the clay and pandermite present retain their original shape. The valuable portion is then readily separated by screening.

After a period of idleness lasting several years, the Russell Borax Mining Co. has again resumed production at its mines in the Ventura district. The control of this company has been acquired by the Stauffer Chemical Co. of San Francisco. During 1914 the period of operation was about seven months, and 3800 tons was produced. This ore gave an average of between 37 and 38% A.B.A.

The total production of borate ore in the United States for 1914 was probably about 65,000 tons, although official figures for this period are not yet available.

Refineries are operated in the United States at Bayonne, N. J., Brooklyn, N. Y., New Brighton, Penn., Chicago, Ill., and San Francisco. The San Francisco refineries are operated principally to supply Pacific Coast and Japanese trade.

At a point four miles west of Rich station in the Kramer district, San Bernardino county, colemanite was discovered in 1913 while drilling for water on a ranch. Mineral locations were filed on the land, these being sold to John Ryan, general manager of the Pacific Coast Borax Co. The purchase price was $4000, of which $1000 was paid in cash. The contest between the mineral and agricultural entrants was decided in favor of the former, the evidence showing that the colemanite body was encountered at a depth of 369 ft. below the shale, and continued until a depth of 410 ft. was reached. The testimony brought out the statement from Ryan and his engineers that the deposit was considered sufficiently valuable to justify operation, the ore being exceptionally high-grade. Some of this ore gave an analysis of 47.9% anhydrous boric acid; theoretically, pure colemanite should run 50.9%.

Chilean borate deposits have been the largest producers for many years, the yield from this country being usually about 75% of the world's production. The mines of Chile, as well as those of the Argentine and Peru, are controlled by the British company.

It is expected that Peru will shortly become a large producer through an agreement made by Borax Consolidated with the Peruvian government. This arrangement provides that the company shall build furnaces capable of treating at least 40,000 metric tons of borate ore annually, and at its option, the company shall construct either a railway or tram-line connecting the mines near Arequipa with tide-water.

Some borate ores are annually mined from the British company's deposits near Tres Morros, Argentine. This ore is not sold, its production being incidental to the performance of annual labor required by the Argentine statutes. The cost of transporting this ore to a shipping-point, and other high costs, will likely prevent the commercial exploitation of these deposits until the cheaper sources have been exhausted.

Dead-Burned Magnesite

California magnesite mines yielded about 12,000 tons in 1914, some of which was sold at somewhat higher prices than those prevailing in the previous year. This industry will probably suffer some reverses during the present year unless producers are prepared to offer a dead-burned product for use by steel manufacturers. American magnesite is purer than much of the foreign article, and when properly selected and burned, is highly satisfactory in Sorel or magnesian cement. As such it has found an increasing demand in the manufacture of so-called 'sanitary floors.' These floors have distinct advantages over those of cement concrete and they are cheaper than tile floors. Magnesite floors may be layed over large areas in a solid mass without cracking, they do not absorb moisture, nor dust, as in the case of concrete. Building construction, however, is at a low ebb, and is likely to continue so for the present. For this reason the demand for light-burned magnesite has fallen off during the past few months, while there has been active inquiry for steel-makers' grade. The latter does not seem to be available here, in spite of the disposition of purchasers to secure a supply here. Austrian magnesite contains an appreciable percentage of iron oxide, and is preferred in open-hearth work for this reason. The presence of this impurity results in the lowering of the point of fusion, and at a given heat the magnesite becomes plastic. It is then tamped into place, and on continued heating it again becomes hard or 'sets.' On account of its high degree of purity, the California material possesses no such virtues, although one California manufacturer has considered a plan of adulterating his product by the addition of hematite.

Refining Manganese at Alameda

After the many unforseen delays that usually precede every new enterprise, the Western Manganese Co. has commenced refining manganese ore in its plant at Alameda, California. In February of this year the company purchased the Old Ladd manganese mine in the Livermore-Tesla district, which was probably the largest producer in the state 20 years ago. The mine was sold in 1902 to the Louraine Mining Co. by the Caires, and subsequently passed into the hands of the now defunct California Safe Deposit & Trust Company.

In the Western Manganese Co.'s plant, which was described in detail in the issues of the Mining and Scientific Press of January 30 and February 13, the ore is crushed and refined to a high degree of purity in order to meet the requirements of the manufacturers of dry and LeClanche cells, glass, terra cotta, paint, and chemicals.

Since the purchase of the mine, development work has resulted in the exposure of a mass of excellent ore. This orebody had been reached by the workings of some prior owner and subsequently, for some reason, concealed by fills of waste rock.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Gypsum is soluble in 500 parts of water and completely soluble in boiling hydrochloric acid.

Clastic is a geologic synonym for fragmental; it comes from the Greek word *klastos*, meaning broken.

Amalgam is a mixture of gold with mercury, made easily on account of the fact that mercury exists in a molten state at the ordinary temperature.

Boring holes in rubber corks is somewhat troublesome. By wetting the cork and borer before and during the operation holes are easily made. Always start at the smallest end in boring corks.

Baltimorite, a hydrous silicate of magnesia, is a white to bluish fibrous mineral associated with serpentine. It can be used for packing steam-pipes, etc., and roofing material, like asbestos.

Where two contiguous claims, one having timber on it and the other none, are held by one owner he may take the timber from one claim and use it for development work on the other.

Mercury solidifies at −40°C. and boils at 360°C. It begins to vaporize at 15°C., if not lower; and of all the metals it is the worst conductor, its conductivity being 5.33 as against silver at 100.

Lead nitrate has been used as a substitute for lead acetate at some South African cyanide plants, the supply of the latter being cut off by the War. It was found to be satisfactory but more expensive.

Wire-rope guides were used with great satisfaction at the main east shaft of the Inspiration mine, Arizona, while it was being concreted. During this work flexibility was desirable; the ropes proved to be so.

Sun-power for raising steam has been used on a working at Meadi, in Egypt. There reflectors of silvered-glass throw the sun's rays on a thin long vessel, made of zinc and painted black, through which the water passes.

Flouring is the minute sub-division of mercury by mechanical means, and 'sickening' is the rendering of such a condition persistent by the coating of the globules of mercury with a film of foreign substance preventing coalescence.

Few claims within Forest Reserves that are presented for patent comply with all the Federal and State laws in every particular. This is usually due to lack of knowledge, as the requirements are different in different states, and as most prospectors and miners operate in several states they confuse the various regulations.

Pumps mounted on scows were used for draining Kerr lake, Ontario, because the shore-line constantly changed as the water-level was lowered. The scow was kept near the shore in order to avoid using pontoons to support the pipe-line.

Cost of drill-steel and sharpening includes not only the cost of the steel and the wages of the blacksmith, but also its proportion of total shop-cost, the delivery of sharpened steel to the faces, and the returning of dull steel to the shop.

Sintering devices, such as Dwight-Lloyd machines or Huntington-Heberlein pots, cannot be used with lead-ore mixtures that contain over 15 to 18% sulphur. When more is present, the ore must be subjected to a preliminary roast.

Cut-out shots can be prevented to a considerable extent by using regular-burning fuses and allowing a longer time interval between the different shots. No detector devised to indicate cut-out shots has so far proved satisfactory in practice.

Linarite is a basic sulphate of lead and copper, occurring often in deep-blue crystals. It can be distinguished from azurite, the blue copper carbonate, by the acid test, for it will not effervesce when acid is applied. The mineral is named after Linares, in Spain.

Caving of ground in mines is usually accompanied by concussion of the air, which is destructive for considerable distances from the cave itself. Broken rock occupies about 50% more space than when in place, so that a sudden caving displaces a great volume of air.

Mine waters may be acid near the surface, but are invariably neutral or alkaline in depth. In some mines the decrease in acidity with depth has been shown by analyses from different levels. The decrease of acidity is accompanied by a similar decrease in the salts of heavy metals present.

Tube-mill pebbles are sold in eight sizes, the smallest varying between 1 and 1½ in. diameter and the largest between 4¾ and 7 in. diameter. Danish pebbles are preferred because of their homogeneous character, giving the longest service and consequently the least cost per ton. They cost $11 per long ton in Denmark, $15 per ton in New York, and much higher figures delivered at the mills. Thus at Round Mountain, 72 miles by wagon-road from Tonopah, the delivered cost is $62.50 per ton. These figures explain why various domestic substitutes are not usually satisfactory—the delivered cost of pebbles, say, from California would not be much less than pebbles from Denmark, while the daily consumption of the latter is much less. The results of experiments on domestic pebbles in Nevada mills were given in the Press of January 23, last.

California Minerals at the Exposition

Many California and other mining men will be disappointed in the way in which the mineral resources of the state are displayed at the Panama-Pacific Exposition. This is no place to discuss the reasons of the arrangements, but it is a pity that some agreement could not have been made whereby an industry producing nearly $100,000,000 per year was given prominence at the Fair. Oil contributes about $50,000,000, gold over $20,000,000, copper over $5,000,000, quicksilver about $600,000, and building materials over $15,000,000 of the total, yet representative minerals of these classes are shown in three departments.

In the California State pavilion is a neat collection. Prominent features are the following: A life-size statue of James Marshall, who discovered gold at Coloma, Eldorado county, in January 1848. Below him are large samples of ore from Amador, Butte, Eldorado, Nevada, Plumas, Shasta, and Trinity counties. At the front of the exhibit at each end, is a square pillar composed of many California ores. Between these pillars are two round ones. Their bases are of Shasta iron ore and pig iron supporting blister copper surmounted by slabs of marble and tiles. A short 'adit' shows part of the 'Cosmopolitan Mines Consolidated' property. We reserve judgment on

SOUTH EUREKA MINE AND MILL, AMADOR COUNTY.

this exhibit. At the mouth of the adit is an improved Matteson ore-car, made by the Joshua Hendy Iron Works. At the back at one end of the booth is a pillar of asbestos from the Stevens mine, Shasta county. Farther along is a pillar of Heroult iron and ferro-manganese from the same county. A 10-stamp mill (20 lb. each, by D. D. Demarest Co.), with plates, No. 5 Deister concentrator, driven by a Westinghouse motor, is instructive. It is operated; clean-ups have been made, and concentrate is to be shipped to the smelter. Part of Trinity county has been transferred to the booth. This county has contributed $200,000,000 in gold. A model hydraulic mine shows the face, water-supply, two Hendy giants (Bonery patent), and sluice-boxes. A model Yuba dredge, described in the PRESS of May 29, and similar to the one in the Palace of Mines and Metallurgy, is ready for work. In addition to these features, there is a lecture room in which actual mining operations in the state are shown by moving pictures.

Rather well arranged are eight safe show-cases, really steel safes, which are locked at night. They contain many thousand dollars worth of ore and placer gold. The Amador case displays Kennedy, South Eureka, Gwin, and other mine specimens, Butte—gold ore, dredge gold, and diamonds; Eldorado—ores, nuggets, and leaf gold; Nevada—North Star, Golden Center, and other; Placer—fern-leaf gold and other shapes, owned by the county and other people; Sierra—gold ore from the Tightner, White Bear, Twenty-one, Ironsides, North Fork, and Empire; Trinity—ores and nuggets; and Yuba—a splendid lot of dredge gold and some platinum.

In a number of large cases are samples of typical ores from 226 mines in the following counties, with the number of mines exhibiting from each: Amador, 18; Butte, 24; Eldorado, 32; Nevada, 22; Placer, 13; Plumas, 25; Shasta, 38; Trinity, 31; and Yuba, 23. One case contains something of historic interest, this being a volume containing the 'Constitution and By-laws of the Ancient and Honorable Order of Independent Miners,' Jone valley, California, instituted March 19, 1853.

Mineral waters, Colusa sandstone, and a classic pillar of granite by the Pacific Granite Co., Rocklin, Placer county, are also on view.

In the Palace of Mines and Metallurgy is another California mineral exhibit. This is the result of co-operation of some mining companies and the State Mining Bureau.

Two steel safes contain specimens and placer gold from Amador, Eldorado, Shasta, Sierra, Siskiyou, Trinity, and Tuolumne counties. Visitors to the Bureau in the Ferry building will recognize the model Union Iron Works 5-stamp mill here. Large cases and benches display the following: Cerro Gordo mine, near Keeler, Inyo county—case of silver-lead and copper ores, native silver on lead carbonate, zinc carbonate, and galena; bench of building materials—granites, basalt, lava, volcanic tuff, slate, pumice, and limestone; bench with large samples of ore from Calaveras, Kern, Mendocino, Santa Clara, Shasta, Siskiyou, Trinity, and Tuolumne counties; case

VIEW NEAR THE GLOBE MINE, IN TRINITY COUNTY.

of mica, garnet, quartz crystals, tourmaline, etc.; tungsten from Kern and San Bernardino counties, Atolia being in the latter; case of mercury ores and metal from Lake, Mendocino, Napa, San Benito, Santa Clara, San Luis Obispo, Solano, Sonoma, and Trinity counties; Kern county case of sulphur, antimony, gold, silver, kaolin, etc., ores; Shasta county case with copper ores from Bully Hill, Mountain Copper, Arps, Minnie Haley, Afterthought, and Mammoth mines; asbestos, talc, magnetite, barite, and glass sand from Shasta county; copper ores from the Penn mine at Campo Seco, and Union at Copperopolis in Calaveras county; and other cases containing gold, fossils, and the rarer minerals.

Of interest is the first pig iron cast by the California Iron Co. at Clipper Gap, Placer county, on April 23, 1881, and the iron made by the Nobel Electric Steel Co. at Heroult, Shasta county.

With a painted background, representing typical California mountain mining districts, is a model hydraulic mine. It includes in operation water supply, three giants, derrick for boulders, hydraulic-filled dam for tailing, and shows the use of the clear water for irrigation.

Attracting a good deal of attention is the glass model of the Mammoth copper mine of Shasta county. The vein system and underground workings are easily followed. The company also displays ore, matte, blister copper, and photographs.

All phases of mining in California are shown by numerous photographs.

A novel, but very instructive reproduction of the oilfields of California is nearly complete on a platform above the mineral exhibit. Wells are shown by aluminum rods. The depth at which oil is struck is marked on them, and all are connected.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

JOPLIN, MISSOURI

Changes in Mine Ownership.—Porter Estate Drainage.—New Mills.—Profitable Dumps.—Sludge-Mills.—Other Activities.

Several zinc mines have changed ownership recently. These transactions have been caused by the high prices of zinc blende. It is noticeable, however, that the majority of purchasers are men who either live in this district, or who already had mining interests here. One of the deals at least involved a sum in excess of $100,000 while the others ranged in price from $50,000 down.——The O. F. & L. Mining Co., operated by Lown & Hastings, at Duenweg, sold its mill and first lease of 24 acres of the Boston-Duenweg land, to S. Y. Ramage, of Oil City, Pennsylvania, and associates. The Ramage interests already operate the Ramage-Center Creek mine at Webb City, Missouri, and are planning to construct three new concentrating plants on fees recently purchased in the west Joplin district. Another 40-acre lease of the Schifferdecker land, in west Joplin, has been purchased by the Ramage interests for $30,000. Other purchases by these people have been noted in the Press.——W. Kenefick, of Kansas City, president of the Missouri, Oklahoma & Gulf railroad, and his son-in-law, J. W. Hoffman, of Kansas City, who operates coal mines in Oklahoma, purchased from Jamot Brown a first lease on 55 acres of land which Mr. Brown owns in fee at Porto Rico, six miles northeast from Joplin. The purchase price, which is reported to be $30,000, takes in the large electrically-driven mill of the Thanksgiving Mining Co. The new owners intend to place the mine in operation at once. It had been idle two years. Sheet ore, occurring at a depth of 185 to 200 ft., will be mined. The mill, which has a capacity of 300 tons per shift, will be worked double time.——The Hurry Up Mining Co., of Webb City, of which James J. McClellan is manager, has purchased for $50,000 the 30-acre fee and mill of the Portia Mining Co. at Galena, Kansas. The mine and land was owned by S. R. Ping. Work will be carried on at a depth of 100 ft. The mill was built six months ago and has been a good producer since that time.——Herbert Taylor has purchased from B. Painter and C. G. Townsend their one-third interest in the Open Air Mining Co. on the Crown Crest land at Duenweg. Development is being done at a depth of 130 to 150 feet.

Several small companies are working on the Porter estate of 40 acres in what is known as the Kansas City bottoms, in the east-central part of Joplin, and plans are proposed by which several large pumps will be installed in the old workings of some of the famous mines that once operated on this tract. The old Kirkbride mine was one of the large producers of the Joplin district about 15 years ago, but owing to low ore prices that then prevailed, work was abandoned and water was permitted to accumulate in the old drifts. The task of draining this property has been considered difficult, but efforts will now be facilitated through the fact that large pumps are working in the immediate vicinity. Just to the south of the Porter estate, on leases of the Missouri Lead & Zinc Co., several large pumping plants are busy, and the ground has been drained to a depth of 100 ft. To the north of this land, B. F. Wurzel and associates have taken a lease on the Murphy land. They intend to begin pumping soon.

Work will start soon at the Granby Mining & Smelting Co.'s new 500-ton mill on its own land at Granby, Missouri. Construction work on the mill was started two months ago, and is rapidly nearing completion. This will be as large as any plant in the district.——Another new mill that should mean an increased production is that of the Scott Mining Co., of which Haywood Scott is manager. It is situated on a lease of the Ground & Irwin land at Duenweg, Missouri, some distance east of Joplin. Mr. Scott recently purchased the lease from J. M. Evans and others for $12,000. He has since refused an offer of $30,000 for the lease. He is undertaking something new in mill building by employing men on night shifts who work by electric lights. A plant of 400-ton capacity per shift will be completed in 22 days. The mill will be electrically equipped throughout. Mining will be conducted in sheet-ground at a depth of 190 to 200 feet.

With blende selling for as high as $135 a ton, basis of 60% metallic zinc, a figure never before dreamed of, old dumps have been leased. These old piles, once discarded as worthless, are yielding enough ore to make fair profits for those who cull them over. In many cases men, women, and children—whole families—are working on old heaps. Instances are on record in the past few weeks where a single man would clean-up as much as $200 in a week, although the average, of course, is far below this figure. For a hard worker to clean enough ore to net him $50 per week is not uncommon.

The Sweetwater Mining Co., operating on a lease of the Connor land, west of Joplin, has added a sludge-mill of three tables to its plant. D. C. Wise and Pat Tabor recently took this mine over from D. M. Sayers, and opened some new ground. The old property, which had not been productive for two years, is now a steady producer of concentrate that is above the average.——Another sludge-mill is being added to the equipment of the Liberty Bell Mining Co. on a lease of the Expansion Mining & Realty Co., west of Joplin. Five tables and concrete settling-tanks are being added at this place.

Eight-four acres of the Ishpeming, the Knight, and the Avondale lands have been taken under lease by Van Haften and associates, operators of the Gopher mine at Duenweg, Missouri. Their newly-acquired tract is situated at Carl Junction, Missouri, and one of their first steps will be to go into the old ground of the Chicago-Lehigh Mining Co., and extend drifts into the new ground. The old Chicago-Lehigh fill will not be used, as the ore will be carried by tramway to the adjoining mill owned by the United Zinc Company.——The Federated-Knight mill, of 250-ton capacity, situated on the Knight land, adjoining the ground acquired by Van Haften and others, has been purchased by T. F. Coyne. It is to be moved to a lease of the Connor land, south of Carterville, Missouri. There it will be constructed on a lease adjoining his Red Top mill, which is a heavy producer.

The verdict of the jury on the coroner's inquiry into the death of the two miners in the Longacre-Chapman mine, recently, was to the effect that the fatality was due to water and tailing coming from a cave-in of the [illegible]ury Lead & Zinc Co.'s ground. This company was found guilty of negligence in not keeping the water pumped out of the cave-in. Some time ago pumping was done for fear of such an accident, but for some reason not known this was stopped.

During the week ended June 27 the Missouri-Kansas-Oklahoma district produced 4909 tons blende, 248 tons calamine, and 1167 tons lead concentrate, averaging $101.70, $66.10, and $61.74 per ton respectively. The total value was $587,641, and for 26 weeks, $11,303,654.

GOLDFIELD, NEVADA

NEVADA EMPRESS MINE; HISTORY AND PROSPECTS.

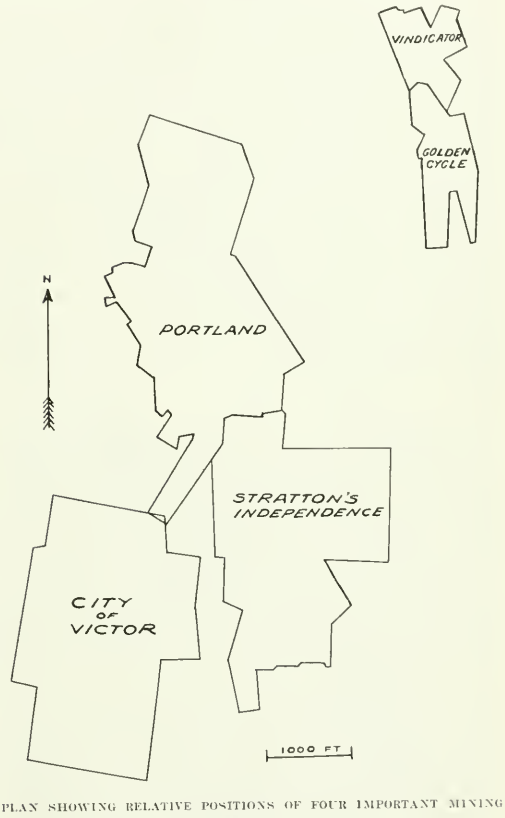
Under the direction of J. K. Turner, consulting engineer for the Nevada Co-operative Mines Co., the latter company is developing the Nevada Empress mine, 46 miles southwest of Goldfield and at the northern extremity of the Gold Mountain district. This is the old Central mine, which was worked more than 40 years ago and which contributed in important measure to the early production and mining history of southern Nevada. Specimens of ore from the Central and the nearby Oriental claims were awarded the highest prize for ore exhibits at the Centennial Exposition at Philadelphia in 1876. The Central is credited with a total production of some $300,000, most of the ore having been carried by mules across mountain ranges and desert to a mill at Austin, over 150 miles distant, some to the old Thorpe mill near Bonnie Clare, and the owner, a 'squaw-man' and recluse, is reputed to have recovered over $30,000 with his own hands, with the aid of a primitive arrastra. Another old-time miner and prospector, by name Vidovich, made his home in one of the adits, high up on the mountain, and in this adit his children were born and reared. Their makeshift bunks, shelves and fireplace, smoke-blackened and stained with grease, remain today as they were in use. Early mining operations consisted of four or five short adits, driven into the steep mountainside, high above the gulch. These adits penetrated the vein and from them the old stopes were extended, in some places so narrow as to permit barely of passage by a man lying down, the richest ore only being extracted. Each adit, in turn, exposed a continuous fault-plane, beyond which no effort was made to find the ore. Stulls of pinion pine, with wedges of the same wood, placed in these stopes and drifts over 40 years ago, appear as if put in place yesterday and show no signs of weathering, discoloration or decay. All the old workings have been connected and all are absolutely dry. The country-rock is granite, exceedingly hard, but breaks freely when once drilled. About eight years ago the Nevada Empress Co. installed a Hathaway gyratory-mill, but this proved a failure. The property was acquired early this year by the C. S. Sprague interests for the Nevada Co-operative Mines Co. A cross-cut adit has been driven into the mountain about 800 ft., nearly 200 ft. below the old adits. This has reached the fault, and a raise is now being driven to cut the foot-wall. There is already a considerable quantity of good mill ore opened, and if the ore is found in sufficient quantity in the lower adit a stamp-mill will be installed. Ample water can be secured within a short distance.

CRIPPLE CREEK, COLORADO

END OF STRATTON'S INDEPENDENCE, LTD.—NEW CYANIDE PLANTS CONTEMPLATED.

The Independence mine has reached another turning point in its career. On June 29, the mine, mill, and all property of Stratton's Independence, Ltd. became a part of the Portland estate. At three o'clock on the above date the deeds were signed at Colorado Springs, and the purchase price was paid over. At precisely the same hour in Victor, the transfer was made a reality. Philip H. Argall, general manager of Stratton's Independence, Ltd., presented to Frank Smale, manager of the mine department of the Portland Gold Mining Co., a tuft of grass with attached soil, a piece of ore, and a key. These emblems, according to an old English custom, symbolized the transfer from one company to the other of the soil with whatever buildings might be thereon, the underlying ores with whatever of precious metals they might contain, and the right of entrance to all the buildings. The Independence mine made the discoverer, W. S. Stratton, famous and wealthy by reason of its large bodies of rich ore. It has brought fame to the past managers because of the new records made in the milling of low-grade, refractory ores. It is to be hoped that the mine still has something in reserve for the new owners. It is expected that the Portland company will start vigorous development. Many applications for leases have been made. Probably all the old lessees under the Argall regime will be allowed to continue to work their blocks. The new leases will be awarded as fast as they can be taken care of.

Rumors are current to the effect that the Franklin Leasing Co. will build a cyanide mill in the district in the near future.



PLAN SHOWING RELATIVE POSITIONS OF FOUR IMPORTANT MINING PROPERTIES AT CRIPPLE CREEK.

This company was organized a few months ago, and has been working the Blue Bird property under lease. This estate is situated on the southwest side of Bull hill, not far distant from the Cresson mine. It is reported that the leasing company has secured an option on the entire holdings of the Blue Bird estate, and that Colorado Springs people have been interested in the property to construct a cyanide plant to treat the low-grade ores on the dumps and in the mine.

It is reported that heavy shipments will soon start from the Hondo property. Situated about midway between the Portland and Golden Cycle groups of claims, the Hondo mine is apparently in a good position to develop into a sizable mine. In the early days some good ore was shipped from the Sitting Bull vein on the claim of the same name. This claim is a part of the Hondo estate. Robert Mullen and associates are sinking the shaft, and a station has just been cut on No. 5 level. It is reported that in sinking the shaft a large body of good-grade mill ore has been exposed. Shipments of this ore are expected to commence soon.

THE MINING SUMMARY

The news of the week as told by our special correspondents and reflected by the local press.

ALASKA

In the U. S. Geological Survey's mid-year review for 1915, Alfred H. Brooks reports that there is every reason to believe that the mining industry of Alaska has begun a prosperous year. The present high price of copper has encouraged the continuation of development work on many copper properties on which operations were suspended in mid-summer of 1914. It is probable that about a dozen copper mines will be on a productive basis in 1915, compared with six in 1914. A considerable increase of copper production will therefore take place. The gold lode production from the southeastern Alaska, Prince William Sound, and Willow Creek districts will also be increased this year. The outlook for an increased output for placer gold is also encouraging. There will be more dredges operated on Seward peninsula this year than last. It is also probable that several new dredges may be in operation in other placer districts before the close of the season. In addition to the dredges there are a number of other placer-mining plants of considerable size that will be operated this year for the first time.

Bethel

(Special Correspondence)—Returning a few days ago from the Aniak river, I passed through the Bear Creek and Tuluksak River mining regions. A good deal of activity existed, preparing for this season's work. Lumber was being cut and supplies hauled from long distances from where it could be obtained. This hampers the development of that part of the territory, as a good many miners have to leave on account of supplies, and others who would like to come are kept out.

A noteworthy discovery was recently made on Kwisluk river that promises to be far better than any previously made. Drill-holes made by a home-made four-inch drill, from 4 to 12 ft. deep gave results from 5 to 7c. to the drill-hole. This certainly is promising.

A Lapp woman last summer on Canyon creek panned $50 from where the bedrock was exposed. The Canyon Creek properties were described in the Press of May 1, 1915. Those mines that were worked last summer were jumped this winter while the owners were down at Bethel, sending up supplies of which a good deal was already on the ground. The mines were jumped on the technicality that they were not recorded in Kuskokwim mining precinct. It appears to be a question of distinctive lines between the Nushagak and Kuskokwim precincts boundary lines. Miners called a meeting and appointed a recorder for that part of the country, until they could be informed to which mining precinct they belong, so they could forward the books of record to the proper authorities. The men who jumped the ground were at Bethel on March 17 for supplies, and went up to start work; while the owners who established a camp last summer, and have the supplies on the ground, are there making preparations for this summer's work. People here are hoping that serious trouble does not arise. It is regrettable that this has occurred. In this particular case there seems to be no question of title. The only argument is which precinct to record in. Until that time the records are on the ground free to inspection of all. It must be remembered that this particular place is over 100 miles from the nearest recording office in direct line in winter, and nearly 300 miles in summer. The law could not be too severe on such aggression, which often ends in bloodshed.

The United States commissioner at Aniak informed me that the McDonald & Bethles quartz mine near Kolmakofsky (Kuskokwim river) improves as depth is attained. Some good specimens can be seen in the commissioner's office.

Bethel, March 28.

Fairbanks

Arrangements have been made by Si Scrafford to ship 2000 tons of antimony ore from the Chatham mine to San Francisco. Reasonable freight rates will be charged by the American-Yukon Navigation Co. Sacked ore, over 250 tons, will be about $15 per ton.

Juneau

The main adits at the Alaska-Juneau mine will probably be double-tracked, according to J. H. Mackenzie.

According to B. L. Thane of the Gastineau company, development at the Kensington, Berner's bay, 60 miles from Juneau, has shown enough ore to warrant the erection of a 1000-ton mill. The first unit of 500 tons is to be designed by the fall; construction will start in spring.

Ruby

Spring clean-ups in the Ruby district are better than expected. Half of the Selch, Deitz, and Walker dump has yielded $80,000, against $80,000 anticipated for the lot. On Long creek A. Larson has opened gravel yielding $7 per foot. At the end of May the town was short of provisions.

ARIZONA

Cochise County

At the Calumet & Arizona plant two blast, three reverberatory, and twelve roasting furnaces are in blast. Large shipments come from New Mexico.——The Copper Queen smelter is receiving a large tonnage of custom ores at present. Eight blast-furnaces are working.

Under the sliding scale of wages, employees of the Copper Queen and Calumet & Arizona companies will be paid on a 19 to 20c. basis, price of copper. The lowest wage in July will therefore be $1.80, and highest $7.

Gila County

One unit of the Inspiration mill started work on June 29.

Greenlee County

The Shannon Copper Co. has issued a report for 1914. For three months the property was idle, owing to the metal market. The smelter at Clifton treated 154,300 tons of ore from the property at Metcalf, and 28,997 tons from other claims. The yield of metal was 9,003,189 lb. copper, 1295 oz. gold, and 60,603 oz. silver. Net current assets total $249,388, exclusive of Shannon Arizona Railway bonds. Experiments with leaching showed good results on oxide ore and tailing. On March 1, 1915, operations were resumed at full capacity.

Pinal County

Underground mining systems of the Ray Consolidated Copper Co. are described by Lester A. Blackner of Ray in Bulletin 102 of the A. I. M. E. With plans and photographs the paper covers 40 pages. Up to 8000 tons per day has been mined. The main orebody is a disseminated deposit in schist and porphyry formed by secondary enrichment. Most of the ore is chalcocite. The deposit covers 205 acres. It averages 121 ft. thick, is up to 2500 ft. wide, and 5000 ft. long. The capping or overburden of leached iron-stained schist, averages 312 ft. thick. There are about 80,000,000 tons of 2.19% ore available for extraction. Owing to the heavy overburden and the low grade of the ore, caving systems have been devised and

adopted which consist in weakening a block of ore by means of shrinkage stopes or ore-filled rooms. Then after undermining and shattering the remaining pillars the ore is drawn systematically, the capping crushing and settling gradually over it. Throughout all the work at Ray two systems have been used, namely, the sub-level or motor-haulage system, employed in thick uniform blocks of ore; and the hand-tramming system, used in the shallower portions.

Mohave County

Construction of the United Eastern 100-ton mill is to be started within the next two months. The vein opened west of

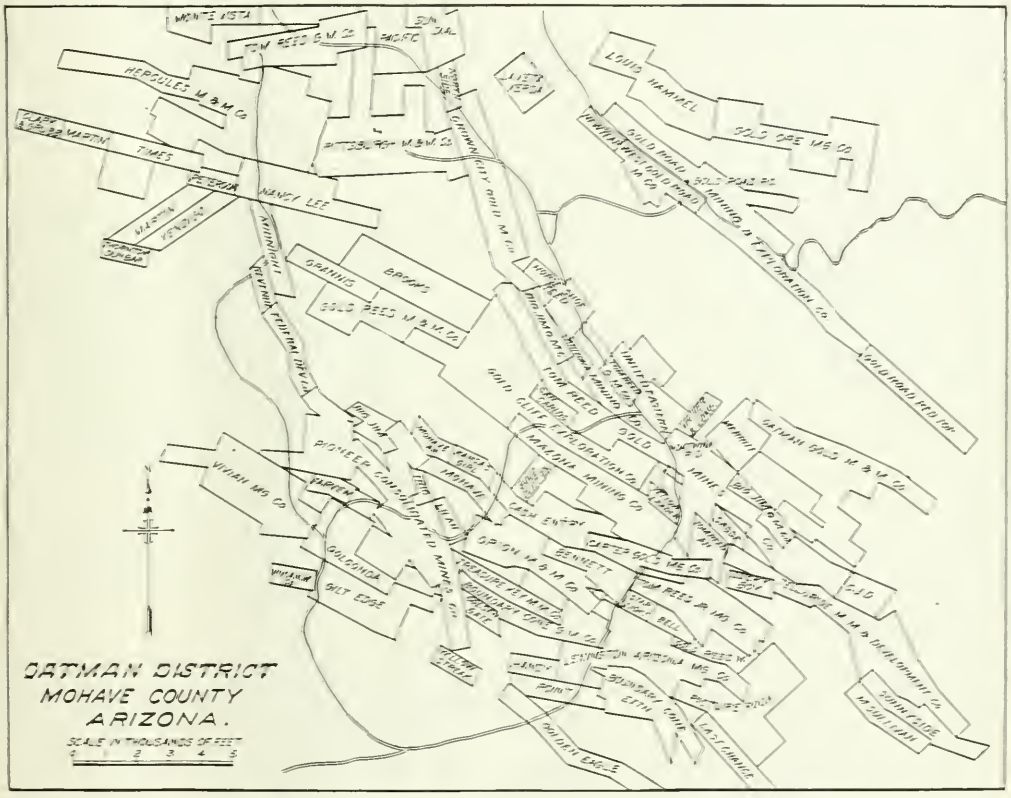
Modoc County

A 10-mile road from Fairport to the Modoc Mines Co.'s property at High Grade is completed. A drainage adit is being driven. A shaft is also to be sunk.

Nevada County

A 100-ft. steel head-frame is being erected at the Brunswick mine. ——Stoking is to be resumed at the Dutch Hill on July 20.

A 100-ft. head-frame is to be erected at the Golden Center mine by R. Hathaway. The new shaft is to be sunk 1000 ft. A 500-gal. Alberger pump has been ordered.



the shaft at 585 ft. is $36.60 per ton over 22 ft. width. It is reported that this company is negotiating for the Telluride property. There seems to be some foundation for this rumor as George Long, director of the United Eastern has consulted with officials of the Telluride.

A custom mill is a possibility for the Oatman district. E. R. Holden and R. Kline have for some time been investigating the reserves of the mines without means of treatment. The plant may be erected on a flat southwest of Oatman. Ores from the district have been tested at Los Angeles.

The Tennessee mine is now 1000 ft. deep. Electric power is to be obtained from Kingman. New machinery is to be ordered.

CALIFORNIA

Amador County

At the Central Eureka the shaft is down 3250 ft. Forty stamps are crushing. One hundred men are employed in charge of J. E. Davis.

Placer County

In the Forest Hill district there is considerable activity in re-opening mines and prospecting. Lessees are also busy.

Plumas County

It is reported that the Plumas Eureka mine at Johnsville, and the Monitor at Gibsonville are to reopened soon.

Shasta County

Farms along Clear creek, near Redding, have been bought by L. Gardella and others of Oroville. The area contains good gravel, and a dredge will be erected there soon.

At Keswick the Noble Electric Steel Co. is making 10 tons of ferro-manganese daily. This is worth $115 per ton in the East. There is 1500 tons of ore awaiting reduction. Eighty men are employed.

Sierra County

A cyanide plant is treating tailing at the Sierra Buena mine at Sierra City. Some of the material is high grade. J. C.

Folsom is in charge.——Although men are busy getting firewood and timber for the Bellevue Gravel Co. at Slate creek, it is not expected that the mine will be worked until after the War. Scotch people control the property.——At the Gardner Point gravel mine near Port Wine, six men are driving a lower adit.——A cross-cut adit nearly 4000 ft. long has been driven in the Sierra Buttes mine. Good quartz has been opened on the hanging wall. About 35,000 tons of tailing awaits treatment at the plant.——At the Young America mine San Francisco people are to treat the 60,000 tons of $1.75 to $2.75 tailing there.

Trinity County

Fifteen hundred acres of placer ground on Trinity river and Coffee creek, from above Carrville to below Trinity Center, have been further optioned till November 1. A large sum is involved if the ground is purchased. E. A. Wiltsee has prospected the area, drilling costing $75,000 so far. More is to be done.

COLORADO

Clear Creek County

In the Waldorf mine near Georgetown the rich stope shows from 18 to 42 in. of ore. The last shipment assayed $118 per ton. It contains a little more lead and less copper than before. Lessees are also doing well.——The Bard Creek company's mill has made its first shipment of 25 tons of lead and copper concentrate.——The Mineral Chief mill is being overhauled. No. 6 level of the mine can supply plenty of ore.——The Capitol mill is working steadily on ore from the numerous lessees, who are doing fairly well. The assayer at the mine, D. Kennedy, is busy testing samples of ore from many prospectors in the region.——Work proceeds as usual at the Virginia City, Key West, and Onondaga mines.

Dolores County

At 404 ft. in the Rico-Wellington mine a 4-ft. vein of zinc carbonate has been cut. Other parts of the mine are looking well.

Gilpin County

The Iron City mill has now a capacity of 80 tons per day. A re-grinding machine is to be installed, increasing the tonnage to 100. It has been said that a good deal of mineral has been lost from Gilpin county mills in the residue run into the creeks. Two weeks ago J. P. Ruth, Jr., had permission to treat slime at the Iron City mill by a flotation process. He expected to recover up to $6 per ton, but of 16 samples the highest was 40c. per ton.——A 10-stamp mill is to be erected at the Two-Forty mine on Pewabic mountain.——Good results are being obtained at the Belden adit, in the Quartz Valley district.

Gunnison County

Lessees at the Doctor mine are about to commence shipping 25 tons of zinc carbonate per day.——The Forest Hill company is working its mine on Trail creek, south side of Taylor park. The 50-ton mill is being re-modeled. There is about 50,000 tons of $9 zinc-gold-silver-copper ore in the mine. L. G. Cavnah is superintendent.——Some mines in Pie Plant gulch will be re-opened this summer.

Montrose County

Mining carnotite and uranium ores is now very quiet, according to O. B. Wilmarth. The Standard Chemical Co. has paid off 200 men and shut-down its plant at Ford. It has tested its new concentrating plant on the San Miguel river.

Ouray County

In May the Camp Bird mill treated 2440 tons of ore. The profit was $23,000.

Saguache County

Sixteen miles southeast of Gunnison is the old town of Iris, which has been quiet for 20 years. Here the Denver City mine is being unwatered and the machinery overhauled. The mine will be examined to see if the zinc and copper veins are worth opening.

San Juan County

In the Silverton district some interesting work is being done at the Flagstaff, Highland Mary, Columbus, Intersection, San Juan Chief, Hermes, Broad Gauge, and Whale mines.

San Miguel County

At Ophir, W. H. Staver, formerly at the Liberty Bell, is preparing for extensive work at the Suffolk and Carbonero mines and mill.——Considerable improvements are to be made by the Tomboy company at its mill this summer.——An addition is being made to the cyanide plant at the Smuggler-Union at Pandora. A transmission-line is being constructed from the upper Sheridan workings of the Smuggler-Union on the Telluride side to the Humboldt workings on the Ouray side of the range.——Ore from the Good Hope and other claims of N. Jurich is to be treated at the Carribeau mill.——There is said to be a good deal of property in Marshall basin available for leasing.

IDAHO

Shoshone County (Coeur d'Alene)

On July 3 the Bunker Hill & Sullivan company paid dividend No. 214. This amounted to $81,750. The total to date is $16,282,500.——At the Frisco mine, at Gem, new crushers, rolls, etc., are to be installed, costing $25,000.

New York people, represented by E. P. Howard, are negotiating for the Rex mine on Nine Mile. F. C. Bailey of Spokane is in charge of the business. The sum of $250,000 has been offered for the property, which is equipped with electric hoist, compressor, pumps, 250-ton mill and other plant. The Rex lead-silver mine is near the Interstate-Callahan zinc mine. The latter distributed $575,000 on July 1. On July 5 the Caledonia company paid 3c. per share, equal to $78,150.

The first shipment of lead-silver concentrate from the Marsh mine in 13 months was sent to Tooele, Utah, on June 29. The shaft is down nearly 1175 ft. from the surface. At the mine 75 men are employed and 15 at the mill.

At the Horst-Powell mine near Kingston, the lessees, A. Page and A. Devlin, have let a contract for a 150-ton mill. About 15,000 tons of ore awaits treatment. On July 1, the Frisco, Green Hill-Cleveland, Morning, and Tamarack and Custer mines were connected with the lines of the Montana Power Co. Previously they got current from the Washington Water Power Co. Competition has lowered rates.

It is rumored that the Hercules company contemplates erecting a smelter at Osburn, as it is not able to make a new contract with the A. S. & R. company.

The Stewart Mining Co. has declared a dividend of 30c. per share, amounting to $371,508. The total for 1915 is $743,017, and $1,919,590 to date.

MICHIGAN

Houghton County (The Copper Country)

On August 2 the Mohawk company will pay $5 per share. The new steel rock-house at No. 5 shaft is well underway. Underground conditions are excellent.——The Franklin mine is milling about 1000 tons per day. Fourteen machines are opening the conglomerate lode.——The Winona is producing about 500 tons per day. Costs are being reduced.——Conglomerate and amygdaloid from the New Arcadian is to be sent to the Franklin mill for a test.

MISSOURI

Jasper County

On June 28 over 1500 miners in the Webb City-Carterville district struck on account of a reduction of wages. The men marched to the mines, demanding that others stop work. There was no violence shown. The cut in wages is from 25 to 50c. per day, and 1½c. per can for shovelers.

Webb City miners last week tried to induce Joplin men to

strike. A branch of the American Metal Miners' Union is to be formed at Joplin.

On July 1 a conference between miners and mine operators agreed on a new scale, based on $80 per ton for zinc blende. No man underground is to receive less than $4 per shift. Following is the scale agreed on: machine men, $4.50; machine men's helpers, $4; mulers, trimmers, and trimmers' helpers, $4; powder men, $5.50; powder men's helpers, $5; tub hookers, $5; hoist men, $5.50; jig men, $5.50; jig men's helpers, $4; sludge men, $4; screen men, $3.50; motor men, $5.50; brakemen, $4.50. Shovelers are to be paid at the rate of 1c. per each 100 lb. of 'dirt' handled. The price of a 1000 lb. can would be 10c., for 1250 lb. 12½c., and for 1650 lb. 16½cents.

At the U. L. Young tracts 7000 ft. of drilling is to be done. Two holes have cut 'jack' at 116 to 125 feet.

MONTANA

Fergus County

(Special Correspondence.)—A large amount of good-grade gold ore is opened in the claims of Frank Finlaw and Henry Allister on the north side of the Judith mountains near New Year. They have done over 4000 ft. of work. Cyaniding will suit the ore.

The Gold Acres Mining Co., adjoining the New Year mine, is said to have an outcrop of mineralized formation for 2300 ft. on its claims. Samples averaged $7.18 per ton. Lime partings will reduce this average somewhat. Condemnation proceedings have been successfully concluded by which the company obtains five acres adjoining its property for use as a dump and building-site. Two shifts are now working on a 1600-ft. adit, together with cross-cuts and a raise which, it is hoped, will expose the deposit so that a better idea of the tonnage and value of the ore can be obtained.

Three prospectors are re-working the placers in Alpine gulch where gold was first discovered in the Judith mountains 35 years ago. The unusually heavy rains have supplied abundant water. The men claim to be making $7 or $8 per day.

Lewistown, June 28.

Silverbow County

Part of the Anaconda company's Washoe plant was disabled last week, and the mines were closed for a time.——At 2500 ft. in the Davis-Daly the shoot has been opened for 150 ft. It is 6 ft. wide, containing from 5 to 7% copper.

NEVADA

'Ground-Water in Southeastern Nevada' is the title of Water-Supply Paper 365 of the U. S. Geological Survey, by Everett Carpenter. The area covered in the report comprises 6000 square miles in Clark, 8500 in Lincoln, 300 in White Pine, and 2000 in Nye counties. Pioche, Caliente, Lund, Moapa, and Las Vegas are in the territory. This lies in two drainage provinces, the Great Basin and Colorado River basin. The most characteristic topographic features consist of a series of parallel north-south ranges, and intervening broad debris-filled valleys. Pine and other trees to native grasses grow from the mountains down. Rainfall is from 3.42 to 11.99 in., the latter at Pioche. The report discusses the occurrence of ground-water, springs, artesian water, quality of water, watering places on routes of travel, and the Railroad Valley district.

Clark County

The Goodsprings district is benefiting from the high price of spelter.——It is reported that the A. S. & R. Co. has purchased the Whale property.——The Azalea, Mohile, Bill Nye, Sultan, New Year, and others are shipping ore. A mill, using a Plumb jig, is working at the Frederickson.——Rich silver ore has been opened in the Akron.

Esmeralda County

The estimated production of the Goldfield Consolidated Mines Co. during June is as follows: ore mined, 32,206 tons; gross extraction, $310,000; operating expenses, $169,000; net realization, $141,000.

Humboldt County

(Special Correspondence.)—The California Ore Testing Co., San Francisco, has completed tests on ore from the Nevada Packard mine. A high recovery was obtained by all-sliming and direct cyaniding. As much as 90% was obtained in the tube-mill circuit during grinding, and a total of 98% after 24 hours' treatment. The tests were made on higher-grade ore than is expected in actual mining, yet a 96% extraction is anticipated on $15 to $20 ore. Silver is the principal metal. The mill is to be one of the most up-to-date in Nevada. It will have a capacity of 100 tons per 24 hours, passing 200 mesh. There will be a gyratory-crusher, rolls, trommel-screen, steel-ore storage-tank, 5 by 6-ft. pebble-mill, Dorr classifier, 6 by 12-ft. pebble-mill, Dorr cyanide equipment, Oliver filter, and zinc-dust precipitation. K. Freitag is metallurgist and constructing engineer.

Rochester, June 30.

At the Nevada Packard there is about 8000 tons of $14 to $22 ore on the dumps. Thirty-five men are employed. Underground developments are excellent.

The new 12-drill motor-driven compressor at the portal of the Friedman adit of the Rochester Mines Co. is working. The adit is in 300 ft. The refinery at the mill is complete. Grading for the railway is finished to upper Rochester. On July 2 bullion worth $40,000 was sent to Lovelock.

Following are the most important items from Willard: Lessees at the Sheepherder's Dream recovered gold worth $425 from 180 lb. of ore. Prospects are considered good at depth. There is 25 tons of $100 ore waiting shipment.——A. Gordon, of Minneapolis, has an option on the Bull Dog and Banjo claims, next to the above mentioned mine, for about $10,000. ——At the Honey Bee a contract has been let for 100 ft. of driving.——Cross-cutting is under way at 50 ft. in the Oddie-Malley-Cole lease.——The Borland-Healey lease adit is in 65 ft.—— Frost and Cahill have a wide vein of rich ore.——Work at the Paulson and Hunter and Grey leases is satisfactory.

Lincoln County

On August 2 the Prince Consolidated will distribute 2½c. per share, amounting to $25,000. Another dividend of equal amount was paid last week. Drilling has revealed encouraging prospects.

Lyon County

Near Yerington is the Pittsburg-Dolores gold mine, one of the leading producers of the district. There is about five years' ore opened in the mine for the mill and cyanide plant of 70 to 80-ton capacity. E. J. Schrader is manager, J. Perry mine superintendent, and C. R. Olsen mill superintendent.

Nye County

Following are the most interesting events at Tonopah last week:

Six companies and lessees produced 10,100 tons of ore worth $207,760.——The Tonopah company dispatched bullion worth $42,000.——On August 2 the Jim Butler company will pay 10c. per share, the first, amounting to $171,802. The balance on hand is about three times this sum. Development continues to be very satisfactory.——The Tonopah Midway shaft is down 1280 ft.——At 1350 ft. the Extension has cut the foot-wall vein. It is 5 ft. wide of good grade.——The Belmont's report for the quarter ended May 31 shows that the revenue was $632,822, and net profit $260,973. Cash, loans, and silver are worth $1,529,-891. Dividend No. 24, of 12½c. per share, equal to $187,500 has been paid. The total is $7,455,510.

UTAH

Juab County

Ore shipments from companies and lessees in the Tintic district last week totaled 169 cars.——At the Lower Mammoth the 1000-ft. level is now producing $15 silver-copper ore. Ten blocks of ground in the mine are worked by lessees. One lessee at 1500 ft. shipped a car of 40% zinc ore.——A 100-ton capacity

ore-house has been completed at the Chief Consolidated. Twenty blocks are being mined by lessees. The total output last week was 20 cars.——Motor-driven pumps at 1600-ft at the Gemini are ready for work.

Salt Lake County

Considerable activity continues in the Big and Little Cottonwood districts. Genuine prospecting and development is noticeable.——At the Columbus Extension the drift to the Toledo fissure is out 180 ft. in heavily mineralized formation. Ten men are employed.——At the Alta Con. machine-drills are now in use. Air comes from the Wasatch compressing plant.——In the Sells, drifts are in the quartzite-limestone contact. The Alpha and Skipper fissures are expected at a vertical depth of 1000 ft. Machine-drills are working here.——Also at the Emma copper mine in limestone shale.——Forty-five teams are hauling 100 tons of ore per day from the Cardiff. The output is to be increased. Fifty men are working at the mine. Electric haulage is to be used.——The Cedar-Talisman has shipped some lead ore and will also market zinc ore.——The Price company has started its adit into Montreal hill. Three units of the Ohio Copper mill are treating over 2400 tons of ore per day. Concentrate is sent to the Garfield smelter. Mining is cheaply done by the caving system, 3,056,000 tons having been extracted since December 1909. Over 200 men are employed.

The Utah Copper Co. is employing 1590 men at the mine, 250 on the railroad, and 1500 in the mills, a total of 3340. The payroll is now over $200,000 per month. The scale of operation is greatly benefiting thousands of other Utah people.

Summit County

Park City mines last week shipped 2917 tons of ore.——Fourteen sets of lessees are busy at the Old Daly, mostly at 800 ft.——On the 500-ft. level of the American Flag mine 30 in. of 2 oz. gold and 30-oz. silver ore has been cut. Ore from this property goes to the Park City Mills plant.

The Silver King Consolidated has issued an interim report along with No. 8 dividend. Early in 1915 the output was only 35 tons daily. From March to June bad roads prevented this quantity being shipped. Everything now is in order for a large output. Higher lead prices have increased profits. Ore between No. 3 and 4 raises occurs as a wedge not less than 150 ft. long and 34 ft. high. Prospects at 1800 ft. are excellent.

Washington County

The population of Goldstrike is nearly 200.——A three-stamp mill is to be erected at the Bee Bee mine.——The Goldstrike Mining & Leasing Co. has a plant of similar capacity. A visiting engineer is reported to have said regarding the ore of Goldstrike, "Go down and you have got it."——A 70-ton mill is to be built for the Goldstrike Consolidated Mining Company.

WASHINGTON

Kittitas County

(Special Correspondence.)—The owner of the Golden Rule placer claim, H. D. Harkness, last week recovered about 11 oz. gold. The largest piece was worth $18.25.——Powers and Sugars have taken a five-year lease on the Trilby placer claim. The drainage adit is in about 200 ft. They expect to cut bedrock in the next 40 ft. The upper part of the claim has been piped off for about 300 ft., and about $11,000 was extracted. The present lessees will open the remainder of the ground, the channel is narrow, and the ground being cement-gravel, stands well.——Craven and Renney are starting to open their placer claims on Lion's gulch.——A. E. Norcross has leased the gravel dumps of the Enekel mine. He is now ground-sluicing.——J. E. Powles is also sluicing the dumps of the Discovery claim.——Johnson and Anderson have started work at the Bigney mine. They expect to cut the north run of Williams Creek vein within two months.——B. Kilsen, of the Hope quartz mine, took out some fine specimen ore in the shaft recently. His arrastra is steadily grinding a good grade of ore.——George Marshall of Vancouver, B. C., has charge of men at the Cougar mine.——Thomas Meagher and others are prospecting Nanem creek on Table mountain. Near the summit there is a flat of over 200 acres; almost anywhere there fine gold can be panned. There is plenty of black sand which has made it difficult to save the gold in the sluice-boxes. They are prospecting the ground carefully, and may devise a scheme to work it on a large scale.——It is likely that the state highway will be built through Liberty. This will give mining an impetus. It will give a first-class road up the Swank and over the Blewitt pass.

Liberty, June 26.

Stevens County

A bid of $128,000 for the Copper King mine at Chewelah, by Danson, Williams, and Danson of Spokane, in behalf of the J. Grier Long estate, H. H. Herbert and A. F. McClaine of Spokane, was rejected on June 25 by Judge W. H. Jackson in the superior court at Colville, and the bid of $125,000 presented by J. W. Douglas, of Orient, associated with Volney Williamson of Spokane, was ordered accepted.

CANADA

Alberta

In two volumes issued by the Department of Mines at Ottawa, the petroleum and natural gas resources of Canada are discussed by Frederick G. Clapp and others. No. 1, with illustrations and maps, covers 378 pages. The production of the Dominion in 1912 was 243,614 bbl. of 35 gal. each, worth $1.42 per bbl. The output of natural gas in that year was approximately 15,286,803,000 cu. ft. valued at $2,362,700. Ontario yielded 12,529,463,000 and Alberta 2,583,437,000 cu. ft.

British Columbia

After several months' shut-down the Standard silver-lead mine at Silverton is again in full operation. The monthly output of concentrate is between 1200 and 1500 tons. The company is shipping this to the Consolidated company's smelter at Trail, a new contract having recently been made.

Six cars of zinc concentrate sent to Bartlesville, Oklahoma, from the Rambler-Cariboo mill in June netted $13,000. Other cars are not settled yet. On account of the expiration of the zinc smelting contract zinc concentrate is being stored at the mill at Three Forks.

Ontario

On July 20 La Rose Consolidated pays $74,931. Since 1908 the total distribution has been $5,322,189.

The Foster mine at Giroux lake has been re-opened after three months' shut-down. The Glen Lake Mining Co. controls the property.

MEXICO

El Oro

Esperanza, Limited, the English company controlling the Esperanza Mining Co., operating at El Oro, has issued its report for 1914. The former's profit was $153,000. Out of this, $101,000 was paid as dividend No. 57 on March 26, 1915. The balance carried forward to 1915 is $20,200, against $14,000 brought forward from 1913 to 1914. Dividends to date amount to $12,000,000.

Owing to the revolution in Mexico, milling ceased on April 21, 1914. In August work was resumed, continuing on a small scale until the end of February of the current year, when treatment was suspended. There were then no facilities for transport of supplies or bullion. The property has suffered no physical damage.

Development on 14 levels totaled 13,277 ft. Of this, 4918 ft. was on the San Rafael vein, 3353 ft. on West vein No. 1, 1130 ft. on West vein A, and 3616 ft. on San Carlos vein. The total was an increase of 130 ft. over that of 1913. Openings to date are 155,467 ft. Much of last year's work resulted in further opening orebodies and old filling. A 4-ton Jeffrey electric locomotive was installed on No. 2 level. Reserves are estim-

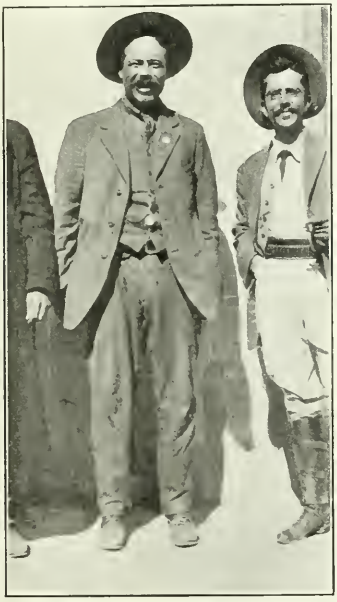
ated at 148,254 tons, containing a profit of $446,000. This does not include old stope-filling or 200,000 tons of tailing on the dump. Ventilation in the south end of the mine was much improved.

The mill treated 120,975 tons of mine ore, an increase of 35,132 tons, and 45,237 tons of old tailing, against 121,438 in 1913. Bullion and concentrate recovered was worth $1,039,698. The working profit was $402,426. Deducting special adjustments, exchange being $85,171, the net profit was $319,967. Dividend declared amounted to $157,500. The balance at the end of the year was $465,757, against $303,289 at the beginning.

The output to date is 2,063,252 metric tons yielding ₱71,289,157.

Guanajuato

At the end of June the three principal mining companies operating at Guanajuato had to shut-down owing to the lack of necessary supplies. The pumps will be kept going, and a few men will be retained at each mine to protect roadways and so forth. All the bullion extracted since the beginning of April has been allowed to accumulate, together with the concentrate. The Carranza forces have held Guanajuato for nearly three



FRANCISCO VILLA AND COLONEL MEDINA.

months, with short intervals of occupation by Villa's troops. Recent decrees of Carranza impose heavy taxes, retroactive to November, but as his authority is precarious, it is hoped that they will not be collected.

Hidalgo

In May the Santa Gertrudis mill treated 13,670 tons of ore with an estimated profit of $24,000.

Sonora

At Nacozari the Moctezuma continues to operate at full capacity, in spite of the railway being closed. A large tonnage of copper concentrate is accumulating. It is possible that the line may be re-opened in about two weeks. Four bridges were burned.

Work has been resumed at the Democrata mine and smelter near Cananea. About 350 men are employed. H. McKey is general manager.

PERSONAL

H. C. Bellinger is at New York.

Bernard H. Sanders has gone to Brazil.

Edgar Bonds is at Tarkwa, West Africa.

Hennen Jennings is expected at Berkeley.

Edward H. Watson is on his way to the Malay States.

C. H. Munro has returned from Colombia to New York.

J. K. Beasley has returned to England from South Africa.

J. G. Lawn, consulting engineer to Barnato Bros., is on a visit to London.

J. K. Turner, of Goldfield, has been inspecting the prospects at Willard, Nevada.

Andrew C. Lawson, O. H. Hershey, and Fred Searles have returned from Juneau.

Milnor Roberts has been visiting on the Comstock lode and is now in San Francisco.

Mansfield Merriman is the new president of the American Society for Testing Materials.

A. H. Lawry, superintendent of the Montana-Tonopah mine, has gone for a trip to Australia.

William J. Priestley, Jr., has been appointed superintend- of the Comet mine, at Basin, Montana.

J. B. Tyrrell has been elected president of the geological section of the Royal Society of Canada.

J. V. N. Dorr will spend most of the month of July in Colorado. During August he will be in San Francisco.

J. Norman Bulkley has been appointed consulting mechanical and electrical engineer to the Canadian Mining & Finance Co., Ltd.

George I. Adams is now professor of geology at Peking University. Franklin R. Barker has been appointed as the successor to Mr. Adams at Pei Yang University, Tientsin, China.

F. Fukeda, chief metallurgist of the Ikuno mine of the Mitsubishi company of Japan and Messrs. K. Hishida and S. Negishi, of the Kuhara Mining Co., were in San Francisco this week and have left for a tour through the principal metallurgical plants of the United States.

Albert Burch has resigned as consulting engineer to the Goldfield Consolidated Mines Co. and as vice-president and general manager to the Aurora Consolidated Mines Co., to take effect at the end of this month. He intends to devote more time to general engineering practice.

Obituary

On June 25, Scott Eldridge, engineer of the Kerr Lake mine and W. B. Foote, a mining investor of Geneva, New York, who was visiting the mine, were instantly killed by a blast that went off at the 250-ft. level when they were in the stope at the 140-ft. level.

George B. Crooks died at San Francisco on July 4. For many years he was connected with John Taylor & Co., the first firm to engage in the sale of assaying supplies on the Pacific coast, and later with its successor, the Braun-Knecht-Heimann Co. He was well known to mining men throughout the West and leaves many friends.

Schools and Societies

The International Gas Congress will meet in San Francisco during the week beginning September 27.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, July 8.

Antimony	.35 —35¾
Electrolytic copper	20½—20¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$95
Spelter	.22 —22¼
Tin	.41 —42½
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, July 8.—Copper is dull, the market still waiting; lead is quiet but firm; spelter is very firm, with a steady demand for nearby delivery.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
July	1	May 26	18.53
"	2	June 2	18.67
"	3	" 9	19.39
"	4 Sunday	" 16	20.12
"	5 Holiday	" 23	20.00
"	6	" 30	20.00
"	7	July 7	19.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended June 26 totaled 6,955,353 lb., valued at $1,208,775. Of this, 3,815,037 lb. went to England, 1,120,263 lb. to Russia (Europe), and 1,033,000 lb. to Italy. Imports of all kinds of copper amounted to 12,418,070 lb., worth $1,358,262.

The estimated output of Michigan in June was 27,000,000 lb. The White Pine contributed about 730,000 lb. of 60% mineral.

The Anaconda yield in June was 22,100,000 pounds.

On June 29 the first unit of the Inspiration mill started work.

During the last two weeks of June the Braden mine, Chile, produced 1,400,000 lb. from 47,079 tons of 2.09% ore.

In May outputs were: Chino, 6,442,000; Nevada Con., 5,271,756; Ray, 5,167,717; and Utah, 14,053,765 pounds

The following dividends are to be paid about July 1:

	Per share.	Amount.
Ahmeek	$10.00	$ 500,000
Anaconda	0.50	2,311,250
Chino	0.75	652,500
Nevada Consolidated	0.375	750,000
North Butte	0.10	172,000
Old Dominion	1.00	293,353
Osceola	3.00	288,450
Quincy	2.00	220,000
Ray Consolidated	0.375	547,042
Utah Copper	1.00	1,625,000
Total		$7,359,595

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
July	1	May 26	49.77
"	2	June 2	49.40
"	3	" 9	49.35
"	4 Sunday	" 16	49.31
"	5 Holiday	" 23	48.97
"	6	" 30	48.40
"	7	July 7	48.10

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.15	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	19.27	....

Weakness in silver continues. In London the market has been lifeless, daily operations small, and interest taken by buyers negligible. Offerings from the United States have been restricted in amount. India and China have not given strength. Exports from London to those countries up to June 16 were approximately 11,000,000 oz. less than in that period of 1914. Stocks in London are about 16,000,000 oz. On July 3 a shipment of 250,000 oz. went to China from San Francisco. According to the last quarterly report of the Tonopah Belmont company, it had silver stored worth $837,455, say, 1,674,910 ounces.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July	1	May 26	4.20
"	2	June 2	4.69
"	3	" 9	5.44
"	4 Sunday	" 16	6.66
"	5 Holiday	" 23	5.82
"	6	" 30	5.55
"	7	July 7	5.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
July	1	May 26	17.79
"	2	June 2	22.10
"	3	" 9	26.17
"	4 Sunday	" 16	22.83
"	5 Holiday	" 23	18.71
"	6	" 30	20.58
"	7	July 7	22.10

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.05	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

Production of zinc and lead ores from the Missouri-Kansas-Oklahoma region for the first half of 1915 was as follows:

Ore.	Tons.	Value.
Zinc-blende	138,145	$9,772,546
Calamine	11,235	479,964
Lead	21,377	1,101,144

Some Joplin people predict that zinc-blende will advance to $150 per ton by October 1, and the year's total at $25,000,000.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June	9	90.00	June 23 ..... 95.00
"	16	90.00	" 30 ..... 95.00
			July 7 ..... 95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On July 7 tin was quoted quiet at 38.75 to 39.25 cents.

Eastern Metal Market

New York, July 2.

Following its recent collapse, spelter strengthened. In the last week it gained 4c., and it is at present firm at about 22c. New York prompt delivery. The largest lead interest has held to 5.75c., New York, for several days. The quotation of others have advanced, and all are now more nearly on an equal basis. Copper is strong, so far as the producers are concerned, as they anticipate a renewal of war buying, but second-hands are offering concessions. In tin, the market has been rather uneventful, the principal feature being the June statistics which showed deliveries of 3900 tons in June. Antimony is strong. Aluminum is scarce for early delivery and its price is maintained.

General business is showing a decided betterment. Great encouragement is drawn from the fact that the improvement is felt outside of the circles which are profiting from war business. The steel mills are steadily growing busier; higher prices are being asked, and the betterment must radiate in all directions. All know that the steel business has been called a 'barometer of trade.' More large war orders are in prospect.

COPPER

For several days the market has been characterized by quiet amounting to dullness, but the quotations of first-hands have continued firm. The presence of several large inquiries from manufacturers of munitions of war has sustained the belief that a buying movement of good-sized proportions will start soon, probably after the Fourth of July holiday. The producers have therefore adhered to their quotations of 20.25 to 20.50c., 30 days, delivered, for electrolytic. Second-hands have offered metal at concessions, particularly in the past two or three days, but it is understood, generally, that not a great deal of re-sale copper is available. For July delivery second-hands might accept as low as 19.62½c., but most of them continue to quote 20c. for spot metal, with the quotation nominal. In Lake there has been a slight show of interest, and occasional carloads have been available at concessions. Quotations range from 20.50c. for common grades to 22.50c. for choice brands. The exports in June totaled 15,751 tons, compared with 28,193 tons in May.

LEAD

Since the last report lead has gained in strength and there has been a steady drawing together of the prices quoted by independent producers and those of the A. S. & R. Co. On June 24, 25, 26, and 28 the independents were quoting 5.50c., New York, while on each of those days the largest interest quoted 5.75c., New York. The re-sale metal which was offered at low prices has been steadily disappearing under buying at the concessions offered, and it is intimated that there is some hidden influence behind its absorption. However that may be, the quotations in the open-market advanced June 29 to 5.60c. and June 30 to 5.70c., the A. S. & R. Co. continuing to quote 5.75c. on both days. Its quotation is still unchanged. That there is still considerable irregularity in the market is evidenced by the fact that a sale was made June 28 at slightly over 5.75c., New York. The London market is so far below New York parity that it is difficult to see how export sales can be made, unless producers are willing to take on export business less than the domestic price. The London quotation yesterday was £25 15s. per ton. The June exports totaled 6606 tons.

SPELTER

On June 25 there was a sharp advance in spelter, some of the producers asking on that day 20 to 20.50c., or 2c. more than had been ruling for prompt metal. For some days the market had been practically dormant at 18 to 18.50c. The advance, and a further upward trend which followed, were attributed to a betterment in the demand and to labor troubles in the Webb City-Carterville ore district, although it is not believed that the trouble will be of long duration. With the price of spelter where it is, it is thought highly probable that the miners will be granted the increase in wages they demand. On June 29 the London market advanced £7 10s. per ton, which was an additional strengthening influence on this market. By June 30, 22c. was asked for prime Western, prompt delivery. Brass-mill specials were quoted at 28 to 30c., and for very choice brands such as Bertha and Horsehead, as much as 40c. was offered. The July and August supply of ordinary grades is not over plentiful. In the early part of the last week in June future deliveries could have been had at 16c.; later they advanced to over 20c. The recent decline in the spelter market, from 28 to 18c., caused the quotations for galvanized sheets to become easier. The present quotation for No. 28 gauge is 4.50c., mill, but the situation is rendered doubtful by the new upward turn of spelter prices. The cables report that the galvanizing trade of England is in an unsettled condition because of the scarcity of zinc, and because of the Government's statement that it may take over the control of the entire supply. The exports in June totaled 2746 tons. The highest New York price in June was 28c., and the lowest 18c. The highest price in London was £110 and the lowest £87 10s. per ton.

TIN

Trading has been light and the trend of prices has been downward. On June 25 the spot price touched 41.25c., having advanced from 41c. quoted the previous day, but the quotation dropped on June 28 to 40.50c., on 29th to 40c., and on 30th to 39.37½c. On July 1, the following flurry of buying of future positions the market went to 39.75c. On one or two days in the week there was fair business in spot metal and early shipments from London, but no really large quantities changed hands on any one day. Quotations are pursuing a more even course than is usual with tin for the reason that the restrictions placed on trading by Great Britain have practically eliminated speculation. The necessity of giving guarantees specifying the ultimate consumers of the metal is a hindrance to free buying and selling. The deliveries into consumption in June reached the excellent total of 3900 tons, 900 of which arrived at Pacific ports, destined for the East. The total of deliveries for 6 months, 21,575 tons, shows a decrease of 1525 tons compared with the same period last year. Shipments from the Straits in June, 6665 tons, were 795 tons larger than for the same month last year. In six months Straits shipments were 862 tons larger than in the same period last year. Australia shipped 141 tons in June, compared with 153 tons in May. The stocks, including on dock and landing, July 1, totaled 2319 tons, and there was afloat on that day 7410 tons. The total visible supply June 30 was 15,927 tons, against 16,027 tons June 30, 1914.

ANTIMONY

Some slight pressure to sell stock on hand led to a softening of prices for Chinese and Japanese antimony in the week, but the easiness was only temporary. Spot metal sold at 36.25 to 36.50c. duty paid. The general quotations range from 36 to 37c. On one or two days there was fair buying, but the needs of ammunition makers seem to be supplied for the present.

ALUMINUM

Prompt metal is scarce and quotations are firm at 31 to 33 cents. Aluminum consumption in the United States in 1914 amounted to 79,129,000 lb. Bauxite production was 219,318 tons, worth $1,069,194.

MINING DECISIONS

Assessment Work—Prima Facie Proof of

The location of a junior mining claim has the burden of proving that the senior conflicting claim was forfeited by failure to do the required annual assessment work. Where it appears that an affidavit by the senior claimant was of record to the effect that the work had been done and there was no proof to the contrary, the Court must presume, under Civil Code Section 1426m, that the work has been done. Where a corporation owns the claim in question a stockholder therein may perform the work and it will inure to the benefit of the corporation.

Musser *v.* Fitting (California), 148 Pacific, 536. March 13 1915.

Mining Corporation—Sale Set Aside

Where the directors of a non-operating mining corporation sold the properties of the Company to the Anaconda Copper Mining Co., for a stock consideration and assumption of outstanding debts by the latter company, and it did not affirmatively appear that the consideration was wholly adequate, upon the suit of minority stockholders a re-sale was ordered to be made in the open market, with the proviso that if no better price could be obtained, the first sale might stand, and the minority stockholders be paid a cash consideration equivalent to the market value of their pro rata of the Anaconda stock.

Geddes *v.* Anaconda Copper Mining Co. (Montana), 222 Federal, 129. May 1, 1915.

The mine in question was the Alice at Butte. The decision was published in the Press of May 8.

Oil and Gas Lease—Gas Well Defined

Where the lessor under an oil and gas lease had permitted his lessee to operate a certain well for seven years as an oil-well, and during that period paid no attention to the small amount of gas which was produced from it in non-commercial quantity, he could not at the end of that period, when the oil production commenced to decrease, recover from the lessee the minimum gas rentals provided for in the lease. A 'gas-well' was defined as a "well having such a pressure and volume of gas, and considered with respect to its location, its proximity to the market, as could be operated profitably, and the gas utilized either on the leased premises or disposed of commercially to others."

Prichard *v.* Freeland Oil Co. (West Virginia), 84 Southeastern, 945. April 20. 1915.

Placer Claim—Forfeiture Denied

A placer claim was located by plaintiff in 1905. Little work done on it until 1913, although the defendant moved into a house on the claim in 1910. In 1913, extensive dredging operations having taken place in the vicinity, and the land within the claim having been known to contain gravel deposits, plaintiff expended time and labor to the value of $135 in clearing off brush on the claim so as to prepare it for dredging. Early in 1914 defendant filed a location notice claiming the ground as having been forfeited by plaintiff for non-performance of assessment work. Held: that whatever may or may not have been done in the way of assessment work during the years intervening between 1905 and 1913 by plaintiff, the work done during the latter year and before defendant's attempted re-location intervened, operated to prevent a forfeiture and plaintiff's claim was held valid.

Richen *v.* Davis (Oregon), 148 Pacific 1130. May 25, 1915.

RECENT PUBLICATIONS

Potash in the Texas Permian. By J. A. Udden. Bulletin 17. P. 59. Maps. University of Texas. Austin, 1915.

The Deterioration of Lumber. By Merritt B. Pratt. Bulletin 252. P. 20. Illustrated. University of California. Berkeley, 1915.

Boone County, West Virginia. By C. E. Krebs, D. D. Teets, and W. Armstrong Price. P. 648. Ill., maps, charts, index. Morgantown, 1915.

John Wesley Powell. Biographical Memoir. By W. M. Davis. P. 83. Illustrated. National Academy of Sciences. Washington, D. C., 1915.

The National Domain in Canada and Its Proper Conservation. By Frank D. Adams. P. 48. Ill. map. Commission of Conservation, Ottawa, 1915.

The Basin and Grey Bull Oil and Gas Fields, Bighorn County, Wyoming. By F. F. Hintze, Jr. Bulletin 10. P. 62. Ill., map. State Geological Survey, Cheyenne, 1915.

The Radium-Uranium Ratio in Carnotites. By S. C. Lind and C. F. Whittemore. Technical Paper 88. P. 28. Illustrated. U. S. Bureau of Mines. Washington, D. C., 1915. A résumé of this paper has appeared in the Press.

U. S. Geological Survey, Washington, D. C., 1915:

Results of Spirit Leveling in Utah, 1897 to 1914. Bulletin 566. P. 77. Ill., index.

Production of Fuller's Earth in 1914. By Jefferson Middleton. P. 6.

Potash Salts in 1914. By W. C. Phalen. P. 25. Map.

Results of Spirit Leveling in Minnesota, 1897 to 1914. Bulletin 560. P. 190. Ill., index.

Results of Spirit Leveling in Idaho, 1896 to 1914. Bulletin 567. P. 130. Ill., index.

The Coalville Coal Field, Utah. By Carroll H. Wegemann. Bulletin 581-E. P. 27. Ill., maps, index.

Lavas of Hawaii and Their Relations. By Whitman Cross. Professional Paper 88. P. 97. Ill., maps, index.

Composition of Muds from Columbus Marsh, Nevada. By W. B. Hicks. Professional Paper 95-A. P. 11. Map.

Lathes: Their Construction and Operation. By George W. Burley. Scott, Greenwood, & Son, London and D. Van Nostrand Co., New York. P. 228. Ill., index. For Sale by Mining and Scientific Press, San Francisco. Price, $1.25.

The lathe is one of the most important of modern machines, for on it depends the successful construction of most other machinery. After a brief, historical review of the subject, the present volume takes up the different classes of modern lathes, namely, hand-turning, engine, turret, vertical and special lathes. The general characteristics and field of use of the different types are considered and there are a number of illustrations showing the principal kinds of each type of lathe. A chapter is devoted to such lathe accessories as chucks, mandrels, etc., and their uses explained. The subject of lathe tools is discussed in connection with tool steels and some space is also given to the questions of feed and cutting speed. Another chapter is devoted to lathe-work in general. The appendix contains tables of gear-wheel combinations for cutting different screw-threads. While the treatment throughout is entirely practical, the underlying principles involved are considered, and the book will be of value to the student as well as to the practical machinist.

New Machines and Devices

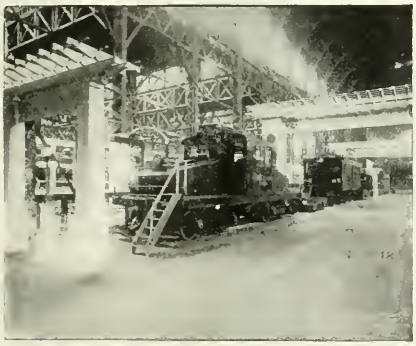
Information based on letters and catalogues from manufacturers.

Electricity at the Exposition

Prominently connected with the Panama-Pacific Exposition is the General Electric Co. of Schenectady, New York. Besides its own extensive exhibits in the Palace of Transportation, the brilliant lighting effect is the work of this company's engineers. These do not cover the G. E. displays, as a complete electrically-operated bungalow, termed the 'Home Electrical,' is open for inspection in the Palace of Manufactures. Many G. E. motors were employed during the construction of the Exposition buildings. In the 'Zone' or amusement part of the Fair, G. E. products are largely used.

In the large artistically arranged court-yard of the Home Electrical the company shows a 'Mazda' service research laboratory for the well-known incandescent lamp. Raw materials, and parts in process of manufacture, explain construction of the lamp. Nearby is the commercial incandescent lamp exhibit, which includes from the 'grain of wheat' size to the large 1000-watt gas-filled lamps. All kinds of other apparatus are displayed. Nearby again is one of the Exposition substations, using G. E. products. It consists of a 1000-kw. motor-generator set, 250-kw. balance set, transformers, switchboard, etc.

The main exhibit of the company covers 9000 sq. ft. in the



GENERAL ELECTRIC LOCOMOTIVES.

Palace of Transportation. Of this, 7735 sq. ft. is for apparatus display, the balance for trackage. The show is ornamental in design. The exhibit comprises electric locomotives for various classes of service from underground mine haulage to heavy steam railroad electrification; railway motors and all kinds of apparatus for electric railways, representing the latest developments in modern city and interurban electric service; signal accessory electric devices; electric apparatus and equipment for railway shops; electric illumination for cars, shops, etc. All essential parts of electric traction are demonstrated in operation.

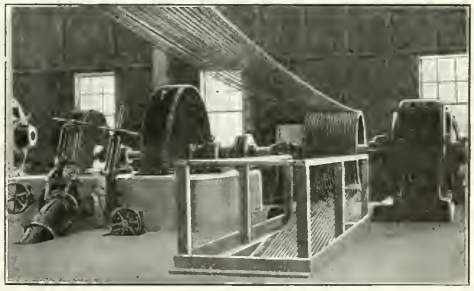
An impressive exhibit is the electric locomotives, of which five different types are included. The Butte, Anaconda & Pacific locomotive, occupying the central space of the group, is one of four units that have recently been built for this road, and is a duplicate of the original 17 units put into service in 1913. These are the first direct current electric locomotives for operation at 2400 volts ever built. Each unit weighs 80 tons. Two are, however, coupled together for freight service to form a locomotive weighing 160 tons. The combination freight locomotives are hauling main line trains of 4600 tons at a speed of 16 miles per hour against the ruling grade of 0.3%, and at 21 miles per hour on level tangent track. Over 5,000,000 tons of ore and supplies are carried annually on this road.

The electric mining locomotives consist of a large 20-ton trolley type equipped with three motors and a six-ton combination trolley and storage battery locomotive equipped with two motors, all of the commutating pole type. The latter is so arranged that it may be operated on the storage batteries for gathering beyond the point where the trolley wire extends, the batteries being re-charged from a small charging set mounted in the locomotive and operating on the trolley voltage, thus obviating the necessity of laying up the locomotive while charging or changing the battery.

Mining men will find the above traction apparatus of great interest. They will also see many other electrical products in the G. E. exhibit, too numerous to mention here. *The General Electric Review* for June especially covers the firm's exhibits, also the use of electricity in many industries.

Combined Water-Wheel and Motor-Drive

At the Snowstorm mine, Larson, Idaho, an air-compressor had been in use for a number of years, driven by an impulse water-wheel, the buckets of which were attached to the rim of what served as the flywheel. The supply of water was limited,



COMBINED WATER-WHEEL AND MOTOR-DRIVE.

so that at certain seasons it was almost impossible to operate the compressor, according to A. O. Gates. Electric-power became available from a reliable supply. It was decided to install such equipment as would allow the utilization of all the water-supply, and keep the compressor supplying the maximum demands of the mine.

Two water-wheels and one motor, mounted on shafts having the same centre-line, connected together by a flexible-coupling, supply the power to drive the compressor. The smaller water-wheel is designed to operate at the full speed of the motor, the two to drive together, the motor delivering the excess power over that available from the water-supply. This varies, of course, with different seasons of the year. When there is less demand for air from the mine the water is diverted to the larger impulse-wheel, which runs at about the same peripheral speed as the smaller wheel (water having same spouting ve-

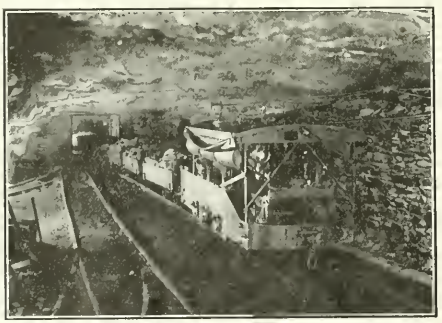
locity), but at about two-thirds the relative speed, the compressor now delivering a proportionate amount of air, and taking less power. The motor is disconnected from the power-line, but turns with the wheels. Thus, by the use of two wheels, the most efficient conditions for water-wheels are maintained during varying loads, the amount of peak electricity being kept at a minimum. On the compressor, the old wheel was replaced with a split cast-iron rope fly-wheel with 18 grooves for 1¾-in. rope. The compressor runs at 90 to 95 r.p.m. at full speed, and about 60 r.p.m. at reduced speed. About 350 hp. is required by the compressor at full speed. As the motor is rated at 275 hp., it must run at an overload during those rare intervals when no water is available. This obtains a better efficiency from the motor at the partial loads of normal operation.

In this plant is another similar compressor, but driven by means of a belt from a single motor. The rope and belt drives of same capacity side by side, offer some interesting comparisons. One of these is the practical noiselessness of the ropes, while there is a hum and crackle to the belt. The rope drive is cheaper in its first installation, and the cost of maintenance is much less than that of belt.

New Gasoline Locomotive

To meet the demand for cheaper transportation in mining and the allied industries, various types of locomotives have been developed. These are propelled by steam, electricity, and gasoline. Among the self-contained units that have resulted is the 'Plymouth' gasoline industrial locomotive. The cost of operating the gasoline locomotive is claimed to be one of the numerous advantages of this type of machine.

The model N locomotive shown in the accompanying photograph is equipped with a four-cylinder 23-34-hp. motor. The



A PLYMOUTH LOCOMOTIVE UNDERGROUND.

cylinders are 3½ in. bore, with 5-in. stroke. They are made from a special grade of reverberatory-furnace iron. The water-jacket heads are cast separately, and being retained by screws are easily removed.

The crank-case is an aluminum casting and the oil-pan is of pressed steel. The enclosed valves are mechanically operated on one side of the motor by a single cam-shaft. The inlet and exhaust-valves are interchangeable. The pistons are of the same grade of metal as used in the cylinders, and are fitted with three diagonally split-concentric expansion-rings.

The connecting rods are of I-beam construction. The cam-shaft is drop-forged, as is also the crank-shaft. The bearings are of nickel babbitt. A thermo-syphon cooling system and a combination of force-feed and splash-system of oiling is employed. A Bosch magneto is used for ignition. Hyatt flexible roller-bearings and friction-drive transmission are parts of the equipment. A heavy two-piece cast-iron frame adds tractive force to the locomotive and makes a very rigid frame.

The shafts and axles are of high carbon steel. The ordinary speeds of the locomotive are from 3 to 10 miles an hour. The draw-bar pull for the 3-ton locomotive is 1200 lb., at 5 miles an hour. The hauling capacity on the level is 27 tons, or 7 tons on a 4% grade. Every part of the locomotive is accessible, and any part easily removed when necessary.

Commercial Paragraphs

A 48-in. Symons disc-crusher, made by CHALMERS & WILLIAMS of Chicago Heights, has been installed by the Garfield Smelting Co., Garfield, Utah.

'National' Bulletin No. 20 of 32 pages is an index for National Bulletins No. 1 to 20. It is in considerable detail, the idea being to offer pipe information readily accessible to the editor, contractor, dealer, or consumer. The index is issued by the NATIONAL TUBE CO., Pittsburg.

An article entitled 'Dragline Cableway is an effective Tool for Sand and Gravel Plants,' by W. H. Wilms, reprinted from *Engineering Record*, June 5, 1915, has been sent us by SAUERMAN BROS., Chicago, who manufacture the Shearer & Mayer patented bucket used in the excavator described. The requirements of the buckets are severe.

In Bulletin Ka, the MESTA MACHINE CO., of Pittsburg, is a useful horsepower chart for transmission machinery including gears and pulleys. The chart appears as a cube with sides 3½ in. square. By writing to the company anybody interested can obtain a blue-print 16 times the size of this chart. Other machinery catalogues have been issued.

According to the NEW JERSEY METER CO., Plainfield, New Jersey, its air-meter is the only type of compressed air-meter which shows instantly, in cubic feet of free air per minute, the actual flow of air in a pipe or hose. It measures the consumption of any tool, machine, or apparatus driven by air; determines the net actual capacity of compressors and detects losses due to leaks, wear, and inefficient tools.

In its 48-page catalogue for 1915 the WEBER CHIMNEY CO., Chicago, states that over 1000 of its reinforced-concrete chimneys are in use in the United States and other countries. A long list is given. The largest is at the Colusa mine, Butte, Montana, and is 350 ft. high. Twenty-three pages illustrate construction methods and finished stacks. Some interesting discussion is given on the Weber 'coniform' chimney.

Centrifugal pumps, (double suction volute), turbine centrifugal pumps, centrifugal pumps, (single suction volute), and two-stage house pumps, are described in Bulletins 150, 151, 152, and 153 respectively of the A. S. CAMERON STEAM PUMP WORKS, 11 Broadway, New York. No. 104 covers the regular piston, boiler feed, long stroke piston, outside packed, sectionalized vertical plunger sinking, and other pumps made by the company.

The R. D. NUTTALL CO., Pittsburg, has issued two catalogues. No. 12 covers mine-haulage locomotive gears, pinions and trolleys, mining machine gearing, mine-haulage and general data for ordering industrial gears. No. 13 gives general data on Nuttall railway motor-gearing for Westinghouse and General Electric equipments, Nuttall trolleys, harps and wheels, flexible couplings of the spring and buffer type, and electric railway compressor-gears.

A 'Pneumercator' is a new accurate and practical apparatus for measuring and indicting the levels of liquids in stationary or marine tanks, such as water or fuel oil. It will also indicate the draft and displacement of ships. The instrument is simple in operation, air being forced through a pipe into the pneumercator by the liquid trying to enter a balance-chamber below the surface of the liquid. At the Exposition the PNEUMERCATOR CO., Monadnock Building, San Francisco, has this apparatus displayed.

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

THE American Mining Congress meets here on September 20, 21, and 22, in the same week as the International Engineering Congress.

AMONG the freight going through the Panama Canal is 65% copper ore from the Kennecott mine, in Alaska, to the Perth Amboy smelter, New Jersey.

SILVER-LEAD ore from the Yukon is being shipped to San Francisco. One shipment of 600 tons, assaying 15 to 20% lead and 100 to 200 ounces silver per ton has just been received at the Selby smelter, and there is more of the same kind to follow. It comes from the McWhorter claims, near Minto Bridge, in the Klondike district.

CESSATION of fighting in South Africa, upon the conclusion of General Botha's successful campaign in German South-West Africa, should prove favorable to mining, by restoring many of the volunteer soldiers to their ordinary work and by preventing further interruption to peaceful industry.

IMMIGRATION for the fiscal year just ended was the smallest since 1899. It was about 460,000, as against 1,403,081 in the previous year. Moreover 362,642 aliens departed, so that the net gain was only 43,000, as against 769,276 the year before. Obviously these facts have a direct bearing on the supply of labor.

METALLURGICAL patents are interesting to our readers; so we have selected, for brief description and illustration on another page, the chief of those recently granted at Washington. This we shall continue to do at intervals. Patents have a large element of the unknown and unsuspected. Some of the apparently least important may prove epochal. Incidentally we note that these efforts to turn ideas into private property include much that seems trivial. The Patent Office Gazette chronicles the patenting of gloves, ties, drapery hooks, clothes-pressers, combination garments, bath-room fixtures, and the like. Attempts to make non-refillable bottles, resilient wheels, shock-absorbers, lock-nuts, and calculating machines are numerous as ever, but why a "device for attracting submarines"?

THE misfortunes of the Treadwell group of mines prove to have been exaggerated. In our last issue we gave the facts as they were transmitted to us. We are glad to state now that the accidents both at surface and underground are considered of minor consequence. The break to the shafting of the hoisting-engine at the Central shaft was repaired by obtaining a piece of shafting 13 feet long from Seattle, this piece being coupled onto a portion of the original. By reason of this quick repair, it was possible to resume hoisting at the end of last week. During the interval ore-crushers were placed at the No. 2 shaft, so as to supply the 300-stamp mill fully a week before the Central shaft became available. To obviate the possibility of any similar interruption to production it is intended to sink the No. 2 shaft to the same depth as the Central, and to keep a duplicate shafting in the engine-house. In regard to the caving of ground, we are informed officially that the loss of ore will not be serious and the workings are not endangered. We are also informed that Mr. Mackenzie's presence at Juneau was a mere coincidence, for he had gone thither in connection with the affairs of the Alaska Juneau mine.

INTERESTING, if true, is the comment to be made on many non-technical statements on technical subjects appearing in the daily press. A paragraph is going the rounds to the effect that the fume collected in the bag-house of the Mammoth smelter, at Kennett, has suddenly become marketable, by reason of its zinc content, for $8 per ton. This is wrong; the fume has been, and remains, unsaleable, because it is not amenable to profitable metallurgical treatment. The fact is that while the fume from the smelting of zinc-lead ores, as at the Selby or Midvale works, can be treated satisfactorily, at least for its lead content, the corresponding product of smoke condensation from complex copper-zinc ores cannot be beneficiated profitably by any method as yet discovered, although the Reed process gives promise of proving effective. As regards the lead-zinc fume, although the lead is recovered, the zinc passes into the slag, so that here also there is an opening for metallurgical inventiveness, such as is likely to be stimulated now, the price of spelter being equal to that of copper.

SOCIALISM is a word so loosely used that it has become discredited, for in the minds of not a few it is regarded as a cross between sentimentalism and anarchy. Socialism with an S may signify something like that; but socialism with an s merely asserts that cooperation is productive of better results, on the whole, than individual untrammeled activity. This latter kind of socialism lies at the foundation of this republic of ours. When the United States came into being the individual states agreed to forego the right to impose import and export duties at their borders, to meddle in interna-

tional affairs, or to advance their interests at the expense of their neighbors. In industry as well, socialism is yearly becoming more important. Much of our industrial progress may be traced directly to it. The activities of the United States Steel Corporation that were described in our issue of March 27 constitute socialism of the most practical kind. It is interesting to note that the opponents of Socialism are among the most ardent advocates of socialism. As an instance, we may quote from the testimony given by Mr. W. L. Saunders, chairman of the board of directors of the Ingersoll-Rand Company, before the Federal Trade Commission. He said: "The desirability of co-operation for foreign business is made acute by the importance and almost the necessity for having a varied line of products. A man who started in with a brake-shoe business, and who has reached out into foreign fields finds that he must also furnish axles, wheels, trucks, cars, and things of that kind to enable him to keep up a large selling organization, and a large volume of business, so as to keep his cost down in dull times. And if small concerns are able to combine and co-operate for foreign business, they would naturally bring into that combination a varied product." There can be no doubt that Mr. Saunders is exactly right in thus diagnosing the fundamental requirements of foreign trade development; we merely rise to remark that if this is not socialism, we do not know the meaning of the word.

WE publish an article on flotation in Australia. In our next issue we shall be able to give our readers the results of some good work with this process in Mexico. Meanwhile we note that in Australia just now it is easier to make a concentrate by frothing a mixture of water, oil, and ore than it is to sell the resultant product. At the annual meeting (in London) of the Zinc Corporation, the chairman, Mr. F. A. Govett, spoke plaintively regarding the inability of his company to sell zinc concentrate under contract with European buyers and the equal inability to cancel these contracts with a view to making new arrangements. To do the latter it was necessary to hale the alien enemy into court, a procedure blocked by sundry physical obstacles. Various schemes to build a zinc smelter in England had been discussed, and abandoned. The duration of the War was a factor so uncertain as to undermine the stability of such an enterprise, for any additional smelting capacity would probably be at a discount when peace was restored. This was the gist of Mr. Govett's remarks. In the absence of some measure of tariff protection or State assistance, it was inadvisable to incur a big expenditure for new plant. Moreover, as regards the erection of any new zinc smelter in Australia, it had to be remembered that the present production of concentrate is based mainly on old accumulations of mill-tailing that are fast nearing exhaustion. The current supply of tailing, or of ore, at Broken Hill will not justify an increase in smelter capacity in Australia, even if, as in England, the labor question did not loom in the background. Mr. Govett stated that 14,000 tons of zinc concentrate had been sold by his company on the American market, but the terms were by no means such as to warrant the expectation of persistent business. This aspect of the matter has been anticipated in our columns; in view of the extra freight and tariff, it is altogether unlikely that much Australian zinc concentrate will be sold in this country.

ON another page we review one of the four guide-books to be issued by the Geological Survey for the use of travelers on the transcontinental railroads. Anyone reading the preface by Mr. George Otis Smith, the Director of the Survey, will realize that this useful addition to the technical library is a minor result of the War, which, by placing an embargo on travel in Europe has diverted the intelligent curiosity of the American public to the less known regions of their own vast domain. In view of the stimulus to home journeys, it was decided "to entertain the traveler by making more interesting what he sees from the car-window." The entertainment is enhanced by making the interest more intelligent, and that in turn is effected by giving the traveler not only maps and photographs but geologic sections and industrial notes covering the physical and human history of the country traversed. These foot-notes are rich concentrates of information, summarizing researches scattered over the pages of many volumes. We congratulate the Survey on an achievement so manifestly useful. Knowledge, like charity, should begin at home. The globe-trotter who wanders across creation from China to Peru while remaining ignorant concerning his own country makes a great mistake, especially if his native land happens to be of such continental extent as to afford air, scenery, and industry of a variety not to be excelled by the rest of the world. He is only less mistaken than the man born in the New World who foregoes the chance to see the Old.

J. A. Holmes

With deep regret we record the passing of Joseph Austin Holmes, Director of the United States Bureau of Mines. This organization was created largely on his initiative and it was proper that he should have been its first administrative chief, having regard also to his fitness for its duties. He died at Denver on July 13 from a pulmonary illness that was known, among his friends, to set a definite limit to his life-work. Like Clarence King, under similar circumstances, he went first to Phoenix and then to Denver, without avail. Only 56 years of age, he had been Director of the Bureau of Mines for just five years, and a technologist on the Geological Survey for the six years preceding, during which period he had achieved honorable distinction as a clever, energetic, and persuasive official. Indeed, he combined tact with sincerity, technical ability with the humanities, energy with foresight, to such an exceptional degree as to render him peculiarly suited to direct the splendid work of the Bureau. He has set an example for those that follow. That is his legacy to his professional friends.

After the War

What most of us know about the course of the War is not nearly as interesting as what we don't know. In any attempts to forecast the result our wish is so much the father to our thought that unbiased judgment is out of the question. As to its duration, that also introduces factors of which we know accurately so little that prediction is futile. We may hazard the belief that the intensity of the conflict makes for brevity. We may assume that the forces acting for peace will gain momentum. In short, being optimistic, as any sane man must be in face of so much to make him pessimistic, we look forward to the end of the Great Horror. Whereupon the question arises: how will the restoration of peace affect the mining industry? It is apparent, in the first place, that the financial status of this country will have been enormously strengthened and aggrandized by the misfortunes of the European nations. A large accumulation of capital will be available for new enterprise. Next, the destruction of capital and of industry in Europe will cause a big demand to be made on the products of American manufacture. In the interval that must elapse before the commercial and industrial machinery of Europe is fully rehabilitated there will be abnormally large purchases of machinery and food supplies. For several years after the War the price of labor in Europe will be so high as to lessen the handicap under which the American manufacturer hitherto has had to compete. The heavy taxation and the increased cost of living will produce economic conditions highly unfavorable to European industry. We say these things in no feeling of exultation but merely in the effort to envisage the future. It is likely that immigration, which has almost stopped during the past twelve months, will be resumed in accumulated volume, for, once the warring populations are released from military service, there will be thousands anxious to leave scenes of horror and devastation in order to start a new life on this side of the Atlantic. Thus, if the United States is not dragged into the War, there should be an unprecedented opportunity for this country to be the manufactory of all that Europe will need for the great work of restoration and reconstruction. All of this will require the use of the metals; during the War for munitions; afterward for the resumption of peaceful industry. The amount of machinery that has been, and is yet to be, destroyed is enormous; the same is true of domestic utensils and appurtenances; moreover, the rebuilding of the world's mercantile marine, decimated by the torpedo and the shell, will call for big tonnages of copper, zinc, and tin. For steel there will be a demand such as the world has never seen. The amount of steel and cement required to repair the ravages of war, in railways, bridges, and buildings of every kind, is enough to stagger the imagination of any engineer. In short, civilization in its material aspect—unfortunately the one aspect emphasized by this scientifically organized calamity—can be restored only by a vast consumption of the metals. That means intensified mining. It means that during the next few years the miner will have to provide the materials required for re-building all that war has destroyed. On this continent the exploitation of mineral deposits is already feeling the stimulus of a great demand, but, unless we are greatly mistaken, it is only a beginning. We have seen some extraordinary rises in the price of metals; we shall see more, and some of them will not be transitory. During the next few years, possibly for a decade, the American mining industry will flourish as never before. The mineral resources of this continent, owing to its detachment from the War and the accumulated capital available in this country, will be exploited with a vigor and a profit beyond the expectation of the most sanguine.

State Mining Bureau

Time was, not many years ago, when the office of State Mineralogist suggested political corruption rather than the organized application of science to industry. California's political atmosphere even now has not the purity of the mountain tops, but it has been enormously clarified since the social upheaval that followed the days of the earthquake in 1906. Nowhere is the improvement more marked than in that part of the Ferry Building where the Mining Bureau is domiciled. Most of those engaged in mining in California have now a kindly feeling for this headquarters of useful information, and for the men at work there. The chief of the department, Mr. Fletcher McN. Hamilton, is a graduate from the State University and in his person represents the highest type of citizenship developed at that seat of learning. He succeeded Mr. W. H. Storms in January 1913; needless to say our good friend Mr. Storms was no relic of the corrupt past, but, let us say, the victim of the interregnum that divided it from the present dispensation. Since Mr. Hamilton took charge, the Bureau has done a great deal of hard work, despite a financial backing that is ill proportioned to the magnitude of California's mineral production. An excellent volume on the 'Minerals of California,' by Mr. Arthur S. Eakle has been published. Much useful labor has been directed to the oilfields, resulting in a report entitled 'The Petroleum Industry of California,' written by Mr. Roy P. McLaughlin, assisted by Mr. R. A. Waring. A complete geological map of the State is being prepared, besides mineral maps of the individual counties, indicating the distribution of the commercial minerals. The compilation of information on this subject has now been done for 35, out of the 58, counties. Naturally the finished work applies to the prineipal mining districts. Moreover, a large quantity of varied information is given, from day to day, in response to correspondence. This is not the least exacting function of the State Mineralogist's office, which thereby gives a helping hand to individuals desiring to exploit the mineral resources of the State. It is a pity, however, that a good deal of the statistical work done by the State Mineralogist should be duplicated by the local offices of

the U. S. Geological Survey and the Bureau of Mines, despite a friendly effort to avoid needless overlapping. It would be to the gain of the community if these various technical activities could be co-ordinated systematically. Meanwhile we can only congratulate the taxpayer that all of these agencies of exact knowledge are giving him a handsome return on his money. For the State Mining Bureau we have a particularly kindly feeling, for it is a home organization that has come through troublous years into a position of respect and appreciation. We recommend the mining population to make more use of it, to go to its library and museum, and give it the active support of a personal interest.

Diaz and Mexico

The passing of Porfirio Diaz may not be so significant as his resignation four years ago, but the event serves to punctuate the close of an era during which Mexico won a recognized position in the comity of nations. His life covered most of the history of the southern republic. He had served in the war that resulted in the transfer of California and the Southwest from Mexico to the United States. It is interesting to recall that the transfer was made under the form of a purchase for $15,000,000 only. He saw the Hapsburg attempt to found a throne in the land of the Aztec; he emerged successfully from the civil strife that followed, and finally with his strong arm fought his way to power as President. For 34 years he was the chief executive of Mexico. That was a long time for an unconstitutional ruler, since the successive elections were but a farce repeated. Yet he won respect and recognition, so that to this day there are many who think that his enforced exile was the worst thing that could have happened to Mexico. They forget that despotisms have one great defect: they do not perpetuate themselves. In the ordinary course of events a despotism ends as it begins, in a revolution. No constitutional successor is available; it is no case of "The King is dead! long live the King," nor is it the simpler way whereby the Vice-President of a representative government takes the chair as soon as the previous occupant has been summoned by a higher power. The downfall of Diaz gave Mexico a brief term under Madero and three years of misrule thereafter. That misrule should have had no suggestion of the unexpected. In the 55 years between the rejection of Spanish sovereignty and the day when Diaz took firm grasp of the reins of power, Mexico had 52 changes of government, all of them established by violence. That average of one per annum has been fully maintained since Diaz was driven into exile. To expect forthwith to establish representative government on the ruins of military despotism is to expect the impossible. Despotism thrives on serfdom. To substitute representative government requires that the foundation also shall undergo radical change. A stream cannot rise higher than its source. Constitutional government cannot stand on a basis of peonage.

That is the problem in Mexico. It cannot be solved by the wave of an enchanter's wand. A compromise is the only thing possible until such time as the native population is given education and freedom. That takes time. Meanwhile the co-operation of those responsible, inside and outside Mexico, may succeed at least in ending the anarchy that has prevailed for three years. Events appear to be marching to that desirable consummation. The man who killed Madero and insulted the American flag has had the impertinence to come to this country and to trespass upon its hospitality by plotting one more revolution. His arrest at El Paso, in company with Pascual Orozco, a bandit who formerly led a revolt against him, is a minor incident in the sordid melodrama. So is Orozco's escape while under bond. Meanwhile Pablo Gonzales has led Carranza's troops to the successful capture of the city of Mexico, defeating the Zapatistas in some minor engagement; but the capital has no military importance, and not much political prestige, now that the treasury has been emptied and the city looted in the course of repeated incursions by various factional commanders. Mexico City is most important as a terminus of the railway to Vera Cruz and a place where many foreigners still linger. Other reports of battles at Aguascalientes and Monclova have come to hand, but the results are stated in terms as conflicting as the official news from Berlin and Paris concerning the fighting in western Europe. As a matter of fact, the fighting in Mexico has been reduced to guerrilla warfare, injurious mainly to peaceful onlookers. In response to the pronouncement from Washington, Carranza remains truculent, while Villa says he is willing to further a compromise, and peace; so say Angeles, Zapata, and others. If Carranza succeeds in further lessening Villa's control in the North, it may prove advisable for Mr. Wilson to recognize him as provisional president of Mexico. That is now probable.

Meanwhile the policy of 'watchful waiting' has proved more pleasant to the spectator than to the victim. Gaunt famine now stalks the land and pestilence like a buzzard flaps his wings. The bodies of dead men hanging from telegraph poles give a picture of something that is not exactly war. From many centres of population comes the cry of starving women and children. The people are weary of misrule and brigandage. Non-combatants, and that means about 99½% of the population, are tired of pseudo-military domination and long for the peaceful revolution that is to end the sanguinary turmoil. The state of Oaxaca has declared its independence of all the revolutionary gangs and announces boldly that it will maintain its sovereignty until the rest of the republic has come to its senses. The merchants of Oaxaca are quoted as saying that they are tired of the exactions levied by the successive factions. Other states may be expected to follow the lead. A Federal government that does not govern is an unnecessary expense. Will the Mexicans accept the aid of their northern neighbor, who has now proved his entire good-will and his disinterested desire to aid in the restoration of order? We believe they are coming to that.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more vaulable than casual compliment.

Precipitating Action of Carbon in Cyanide Solutions

The Editor:

Sir—The recent article in your journal on the above subject by W. R. Feldtmann and one on much the same subject by Morris Green, both of which have appeared in the *Transactions* of the Institution of Mining and Metallurgy, have gone far toward clearing up the mystery that has surrounded the action of charcoal and related products on gold in cyanide solutions. It might be well, however, to call attention to the fact that the two papers mentioned together constitute a strong case for backing up the assertion that this phenomenon can now be explained in terms of known laws.

For many years the precipitation of gold on charcoal has not been understood, and we have been prone to accept the fact as due to some special peculiarity of amorphous carbon which it would be hard to classify with any other phenomenon known. However, since the property of adsorption of ions by colloids has been firmly established, there have been more or less serious attempts to find an explanation for the precipitating action of carbon in cyanide solution, but those doing the work have either been unsuccessful or forced to assume that the adsorption of gold-bearing ions in the pores of charcoal was of a slightly different kind than the absorption of ions by other colloids, or of other ions in charcoal itself. But the work described in the two papers, above mentioned, would seem now to offer an explanation of how gold is adsorbed into charcoal and why it does not behave like ordinary adsorptions.

In the development of colloid chemistry it has been found that there is a class of 'amorphous' substances, such as charcoal, meerschaum, colloidal gels, starch, cotton, wool, glass, coal, etc., which have the property of absorbing great amounts of gases, vapors, liquids, and even ions from solutions on their surfaces. Why crystalline substances do not exhibit the same phenomenon, at least in a measurable degree, is hard to explain, but crystal faces, and molecular orientation, with consequent close packing of the molecules, seem to prevent adsorption.

It has been known since 1777 that charcoal would adsorb gases, but the only work that has thrown any light on the real nature of the process has been done in recent years. Mr. Green has clearly shown that charcoal containing adsorbed carbon monoxide is capable of precipitating gold; that charcoal which has been exhausted in a high vacuum at elevated temperatures shows a very low precipitation value, but that its precipitating value is restored by allowing the CO to be re-adsorbed, or by heating the charcoal in air. Such being the case, it may be well in this connection to call attention to the recent work of Rhead and Wheeler on the mode of combustion of carbon (*Journal* of the Chemical Society, Vol. 113, pp. 461 and 1210, 1913). They found that the charcoal examined would adsorb oxygen, which later combined directly with the carbon of the charcoal, forming a "loose physico-chemical" complex that later broke up into carbon monoxide and carbon dioxide, depending on the amount of carbon monoxide left adsorbed on the surface of the charcoal. This fact explains the sudden evolution of a great volume of oxides of carbon when Mr. Green heated his charcoal *in vacuo* to 500°C. Based on Mr. Feldtmann's inference that a carbonyl aurocyanide is formed by the inter-action of the adsorbed gold-bearing ions and the adsorbed carbon monoxide, we have an explanation of the phenomenon in terms of colloid chemistry. The aurocyanide ions, are doubtless adsorbed in the charcoal in the same way that permanganate ions are, and could be washed out again with an excess of cyanide solution if it were not for the fact that these ions react with the carbon monoxide held adsorbed in the charcoal, forming an insoluble compound, which can doubtless break up still further to form the metallic gold that Mr. Green reports that he saw. When a solution capable of dissolving the compound of gold is used, the charcoal will give up its load in the same way as it gave back the unaltered aurocyanide ions, as shown in the column of figures headed "adsorbed gold" in one of the tables prepared by Mr. Feldtmann. However, even with all of the gold merely adsorbed, there will always be a loss of some gold held adsorbed on account of the fact that there is a definite equilibrium reached between the solution and the adsorbed ions and that the latter can only be completely removed by an infinite number of washes. These conclusions are based on colloid-chemical principles. I am of the opinion that it would be well to take these facts into consideration in connection with Mr. Feldtmann's work, even to a greater extent than was done by him. For example, he was able to re-dissolve all of the gold in alkaline sulphide solutions, but it would have been a most interesting experiment if he had applied another cyanide wash after all of the insoluble carbonyl aurocyanide had been removed from a sample of charcoal saturated with gold. This might have shown whether there was any free gold formed in the pores of the charcoal that had been protected from solution in cyanide by the insoluble carbonyl aurocyanide.

It is easy to see, in the light of Rhead and Wheeler's work, why charcoal is re-vivified for the precipitation of gold by simply heating in air, as more carbon monoxide is generated in the pores of the charcoal. It is also easy to see why freshly-heated charcoal has a higher precipitation power than charcoal that has stood some time, as the freshly-ignited charcoal is doubtless saturated with carbon monoxide, while in the older samples, part of the carbon monoxide had diffused away faster than the carbon-oxygen complex could break up at ordinary atmospheric temperatures. Moreover, the fact shown in Mr. Feldtmann's tables of figures that the charcoal never becomes quite saturated, but continues to precipitate gold slowly, is to be coupled with the slow breaking-up of the "physico-chemical" complex into carbon monoxide and carbon dioxide, due to the removal of CO by combination with the aurocyanide ions. Mr. Feldtmann ascribed this latter effect to some other chemical reaction that might be set up, but the figures upon which he bases this surmise show only one figure that could uphold his assumption. This table is quoted below, together with an additional column of figures, showing the velocity of precipitation of gold during each successive interval observed by Mr. Feldtmann:

Contact, hours.	Gold precipitated, mg.	Mg. gold per hour.*
3	14.0	4.67
6	16.2	0.73
9	18.0	0.60
12	19.6	0.53
18	20.6	0.17
24	20.8	0.03
36	22.0	0.10
48	24.2	0.18

*This column I have added.

If the figure for the 24-hour period were discarded, it would be hard to draw the same inference as Mr. Feldtmann. Not knowing the care exercised in these experiments and how much reliance Mr. Feldtmann is ready to put on one figure, I am not prepared to criticize the observation further than to call attention to the fact that a continued precipitation of gold could easily be explained on the ground of facts already known about charcoal, and which do not call for the assumption made by Mr. Feldtmann.

Mr. Green was not able to make carbon monoxide react with a cyanide solution of gold by simply bubbling the gas through it, but felt that the high state of pressure of the adsorbed gas in the pores of the charcoal might easily account for the reaction taking place. In this, I fully concur. The work of Dewar indicates that the density of several adsorbed gases is greater than, or nearly equal to, the densities of these same gases when liquified. Thus CO_2 when liquified at a temperature of 15° C. has a density of about 0.8, while the density of the CO_2 adsorbed in charcoal is at least 0.7. These measurements made by Dewar more or less justify Mr. Green's inference, and only illustrate the magnitude of the forces at work, be they those of adhesion or what not, that cause the concentration of films of gas or of liquid on the surfaces of this kind of amorphous substance. In the case of water adsorbed on starch grains it has been estimated that the force acting is 2073 kilo. per sq. cm. (Rodewald and Kattein, in *Zeit. Physik. Chem.*, Vol. 33, pp. 540-544 and 593-604, 1900). For this reason it is not at all surprising that Mr. Green was able to make small amounts of gold precipitate on charcoal that had been heated in a high vacuum to 500° C., as a perusal of Rhead and Wheeler's work will show that they went to much higher temperatures without being able to remove all of the adsorbed gases from the charcoal. Furthermore, it is a matter of common knowledge that there is a film of adsorbed air, moisture, etc., on the surfaces of glass vessels, that cannot be completely driven off, even *in vacuo*, at temperatures as high as the softening point of glass. This fact has been observed repeatedly in the incandescent lamp industry.

All of the amorphous substances mentioned, such as charcoal, meerschaum, etc., when immersed in solutions, likewise tend to adsorb some of the ions from the solutions, and in amounts varying with the substances in question. The laws of adsorption have been set forth in text-books on colloid chemistry, and have been referred to for some time as a possible explanation of the precipitation of gold on charcoal, but it was not until Green had proved that it was connected with the adsorbed carbon monoxide and the formation of an insoluble compound that we really gained an idea as to the true situation. He tried some of the other amorphous substances mentioned and got no precipitation. Supposedly there was no adsorbed carbon monoxide to cause reaction in these other substances. I am not greatly surprised that Mr. Green did not get appreciable precipitation on anthracite coal, as it is too highly compressed a product to have much pore-space, though some action on coke might be expected, but not having descriptions of the history of the coke samples used, it is hard to judge. My own experience with the lower-grade coals, however, is that they act much like charcoal, are capable of adsorbing permanganate ions, and that they adsorb oxygen, with which they combine later (at ordinary temperatures) liberating carbon monoxide, carbon dioxide, and water (see Technical Paper No. 65 of U. S. Bureau of Mines).

Mr. Feldtmann's observation that the use of oxidizing agents such as bromo-cyanogen in the cyanide solution hastened the precipitation rather than assisted in resolution of the precipitated gold, accords with another known property of the charcoal, that property of yielding a mixture of CO and CO_2 when treated with solutions of oxidizing agents. See Hofman, Schumpelt, and Ritter in '*Berichte des Deutschen Chemischen Gesselschaft*,' 1913, 46:2854.) Therefore I feel justified in adding to Mr. Feldtmann's conclusions the statement that facts already known about charcoal, taken in conjunction with well-known colloid-chemical principles, further support the work of himself, as likewise that of Mr. Green, in an explanation of the phenomenon of the precipitation of gold on charcoal.

O. C. Ralston.

Salt Lake City, June 5.

Relative Error in Alluvial Sampling

The Editor:

Sir—Probably no two alluvial engineers are agreed as to the most effective method of sampling gravel. The different types of drills, both hand and power, have their own adherents; and in the same way, different systems of shaft-sampling find varying favor. The tendency of every individual is to favor the methods which have brought the best results in his own particular experience.

Everyone realizes that the personal equation of the examining engineer is the determining factor in the sampling of any property, no matter what the method used. For this cause, the accuracy of any method of sampling may often be brought into disrepute, when the machinery of the sampling itself may not have been entirely at fault. There are, however, certain factors of unreliability which may generally be conceded to be present in all methods of sampling; and it is of a few of these that I wish to treat.

The best known forms of hand-drill are exemplified by the Empire, or Banka, type; and the best known form of power-drill is, of course, to alluvial men, the Keystone. It will suffice for my present purpose to show the chances for error that commonly attend each one of these methods of sampling, in the case of drill-holes.

Again, in shaft sampling, there are two distinct methods commonly used, each of which has its failings. One is the washing of the entire material taken from the shaft through a sluice; the other the sampling of the sides of the shaft by open-cut after it has been sunk.

To begin with the methods of drill-sampling, let us take the case of the Keystone. The commonest form of this drill used in placer prospecting is the No. 3 traction. The weight of stem and bit is about 800 pounds, and the inside diameter of the casing is 6 inches. The diameter of the bottom, or flare, of the shoe, is 7½ in.; hence in order to be assured of the proper core within the casing after a drive of one foot, approximately 18 in. of material should be within the casing. It may be possible to maintain this ratio. Personally, I have never been able to do it, except within wide limits. Where the driving is being done in pay-gravel, the whole question of allowance to be made is simply up to the judgment of the engineer. No established rule will fit the varying conditions of the gravel. Then, having drilled your hole, the best method of saving your entire core is, of course, to pump directly after driving, without using the drill, wherever it is possible to do so. It is possible only in the case of fine gravel. In most cases, the driving-blocks have to be taken off, and the heavy drill lowered into the hole, there to punch out part of the core from the casing. How much? This can only be judged by measuring each pumping—for every drive, that is—and applying a factor of expansion, as well as making allowance for the run-off in slime. This method is absolutely incompatible with making any speed, and the usual practice is to measure up only when the sluice-box begins to get full, or nearly so.

So, you probably do not have the core that you should have for your drive, and you don't know how much of the core you have saved. The sum total of measured volume may, if your luck is good, come somewhere near the estimated theoretical volume of the core. When you come to estimate the yardage-value for the hole, you commonly use a cross-section that lies between the area of the flared shoe and the area of the inside of the casing. The experience of many engineers has shown that Radford's factor, of 0.27 ft., comes somewhere near giving satisfactory results in the majority of cases. In other words, in summing up results, we assume that all other assumptions with regard to the volume of core from which the gold obtained was secured, and of which it is supposed to represent the average content, have been covered by the use of Radford's factor.

Consider next the error that enters into hand-drill sampling. As the usual Empire casing generally used is 4-inch, and the weight of the tools is much less than in the Keystone, the chances are that the errors above mentioned do not enter nearly so far into calculations. There is less material to handle, the rotated pipe undoubtedly does help in securing the proper amount of core, and the total core for the drive may readily be measured up and checked with the theoretical core without cutting down the speed of drilling. In this case, a flexible system of keeping the log is applicable such as is impossible in the case of the Keystone.

On the other hand, the Empire has faults peculiarly its own. The ball-valve pumps certainly drive a portion of the core out when they encounter a pebble too large to go into the opening. A new tool has recently been supplied by the Empire people, called the Knox tool, which is supposed to overcome this difficulty by enabling the removal of large pebbles before pumping. How effectual it is, I am unable to say, not having used it as yet.

Also, in encountering larger than 4-in. boulders with the Empire, a certain amount of error is caused by the pushing aside of material. As there is no flare to the Empire shoe, the factor for one foot is taken as 0.1134. This should be subject to a discount—or rather an increase that will act as a discount factor—just as much as in the case of the Keystone. An arbitrary cutting down of yardage-values by 15% will accomplish the same result, however. This discounting is, of course, a confession of weakness and evidence of a desire to remain on the safe side.

Consider next shaft-sinking. I have contended elsewhere, and still contend here, that no ground is properly prospected without the information derivable from a number of shafts. However, unless the cost of examination is to become prohibitive, no ground can be thoroughly prospected by means of shafts, for obvious reasons. Here again comes the question of the judgment of the examining engineer. How many shafts need to be put down before the drill-sampling may be considered properly checked, and how shall they be placed so as to give the maximum of information for the minimum of expense? The answer to this problem will depend en-

tirely upon sets of conditions, which are never the same for any two properties.

When all of the material is taken from a wet shaft and put through a sluice-box, and the content of the ground calculated from the recovery and the amount of material taken from the shaft, error is certain. Where pumping is necessary, the suction of the water is liable to draw in gold from all around the shaft. I had occasion to check some shaft-work of this type in Oregon recently. The gold was rather light and flaky, and it was evident that the shafts had been unintentionally 'salted' in the above manner to a high degree. In this case, the drill proved to check much closer with the real value of the ground than the shafts. On the other hand, I recall a case of shaft-work done in northern California in exactly the same manner. In this case, however, the holes were absolutely dry. When I came to hydraulic the property afterward, the clean-up results checked startlingly well with the shafts. Had the ground not been pretty even in its gold content, this would never have been the case, of course.

My personal preference of all sampling is to take a measured open-cut down through the bank, and weigh all the gold in it. For this reason, I am an advocate of the second method of shaft-prospecting, namely, that of sampling one or more sides of the shaft after it has been sunk. In the case of wet ground, this method affords some little difficulty, and must be done with extreme care; and in the case of running or loose gravel it becomes almost impossible of accomplishment. Wherever open faces are available, as in old hydraulic workings, this method is applicable, and in Peru I have sampled tailing by dropping shallow shafts and open-cutting the sides. In firm ground, without too much water, this method is, to my mind, the most accurate of all. It may be necessary sometimes to drain the shaft from a sump in the bedrock for a day or two before the ground becomes sufficiently firm to sample in this manner.

However much opinions may vary as to methods, I think it will be generally agreed that the whole thing depends upon the judgment and experience of the man who is doing the work. We naturally expect our drill-manufacturers to be enthusiastic regarding the simplicity and ease of operation of their respective machines; they would be poor optimists did they not—and also poor salesmen. However, most firms prefer to furnish with the drill a man who knows how to operate it, from a mechanical standpoint, but the furnishing of an engineer to direct the examination is naturally somewhat beyond their scope.

We hear a great deal about the accuracy of estimation that is possible through improved methods of drilling, but very little about the possibility of error in the various types of prospecting machines, and the necessity of the use of judgment in eliminating and discounting this error. To me, this is a factor that cannot be emphasized too strongly, even at the risk of being misunderstood.

CHARLES S. HALEY.

San Francisco, July 12.

Conditions in Sonora

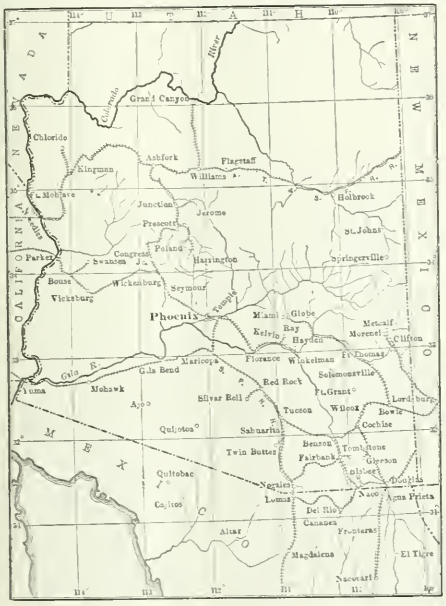
By AN OCCASIONAL CORRESPONDENT

My own experience is largely confined to the northwestern part of Mexico, particularly the state of Sonora. The present confused conditions are due largely to an agreement made with General Scott, of the United States army, whereby the Villistas, or followers of Francisco Villa, were diverted to Nogales while the Carranzistas, or followers of Venustiano Carranza, were centred at Agua Prieta. The intention of this friendly American interference was to prevent promiscuous shooting across the boundary, but in Mexico the agreement produced a condition approaching chaos. The Villistas were ordered by the U. S. authorities not to attack Agua Prieta, but the Carranzistas in Agua Prieta were allowed to raid the Villista country south and west; thus an absolutely impossible condition was created. The railroads running from Nogales to Cananea were destroyed by the Carranzistas, while the railroads running from Agua Prieta to Nacozari and El Tigre were destroyed by the Villistas. Strenuous efforts were made by the mining companies to adjust matters to such an extent as to enable them to continue or start operations, for Cananea was shut-down for several months. These were aided somewhat by the State Department, after Mr. Bryan's withdrawal. Thus eventually permission was accorded by both parties to operate the mines, and to repair the railroads, each side retaining 100% of the war taxes now imposed, these taxes being two or three times greater than those levied before the revolution commenced.

In consequence of the depreciation of Mexican currency and the absolute shortage of provisions throughout northern Sonora, the mining companies and the surrounding population have resorted to what is practically barter. The farmers, when bringing supplies to the mines, will often refuse money, preferring to be paid in coffee, sugar, or clothes. The miners themselves will work for three or four days only, and draw food and supplies from the store, but immediately the mining company refuses to give out any of its limited stock and proceed to pay wages in paper, they cease work. The miners will no longer do a day's work for paper money. In order to offset this, the Cananea mining company, whose mines have been closed for several months at a cost of considerably over half a million dollars, and are now resuming operations, paid their men last week in Mexican silver dollars, which were purchased and shipped from China, to the amount of about $400,000 American currency. This action on the part of the Cananea management has resulted in a strong migration, not only from the mining camps of Nacozari and El Tigre to Cananea, but from the rival contending armies.

The struggles of the Villistas and Carranzistas in Sonora can have no effect whatever on the final pacification of Mexico; their performances partake of the character of *opera bouffe*, were it not for the enormous cost to the American industries operating in that state. These are the chief sufferers. It will be understood that

no white labor is now employed in northern Sonora, except for supervision and technical work. On account of the damaged condition of the railroad south of Agua Prieta enormous quantities of copper concentrate have accumulated at Nacozari and it is reported that the El Tigre mining company has as much as $300,000 worth of bullion and concentrate on hand. Of course, accumulations of this kind serve to invite the disorganized elements of the country to attack and raid the mining settlements, as they did some two years ago when 'General' Inez Salazar raided the Tigre 'camp' and stole some three tons of bullion. When his band of 375 men left



MAP SHOWING THE ARIZONA-SONORA BORDER.

they were loaded with provisions and supplies as heavily as possible. The company at that time was fortunate in that Federal troops were already on the way from the north, and Salazar's band was quickly stampeded, leaving the silver and other loot tied to burros that wandered over the mountains. The bars of silver, each weighing about 200 pounds, were so heavy that when the burros lay down, they were unable to get up again, so that, having been abandoned, they died. The Tigre miners, who were searching the hills for the lost bullion, were able to locate it by means of the buzzards circling overhead. As a matter of fact, every bar was recovered and Salazar was thoroughly defeated by General Obregon, now the right-hand man of General Carranza, in his first battle of any importance.

Power is supplied to the Tigre mine by meaus of a power-line 65 miles long transmitting 1000 horse-power through a current of 40,000 volts. This line has been repeatedly cut by the contending factions, but it is probable that if it were not in existence, the mine would have ceased operations many months ago, as, on several occasions, all the horses and mules belonging to the freighters working for the company have been stolen. So far it has been possible to repair the line as soon as it has been cut.

There has been very little actual fighting in Sonora. There have been no pitched battles, the fighting being of a desultory character. It would almost appear as if the object of both factions was to get into such a position that they could tax the mining companies. The large land-owners have escaped into the United States; the crops planted this year are of small extent, and, while there does not appear to be any case of actual starvation in northern Sonora, conditions could hardly be any worse than they are, the only redeeming feature being the fact that the three large mining companies continue operating to the best of their ability. While unhappily they furnish funds to the contending factions, they also supply a livelihood to the surrounding population.

Nacozari and Tigre will both, no doubt, be compelled to adopt the Cananea plan of paying in Mexican silver, although the Villista faction now in control in Sonora (with the exception of Agua Prieta) is already objecting to the abandonment of the use of the paper currency printed by them. There is no doubt that the payment of silver itself to the miners will tend to expand the barter now in vogue, as all the various paper issues, which now amount to many millions of dollars, are legal tender, and are refused by everybody who can. Speaking generally, the outlook is that unless some one of the contending factions is speedily recognized by the American government and permitted to strengthen itself by means of foreign loans, the United States will be compelled to intervene, willingly or unwillingly. If the United States fails to recognize any government in Mexico, the present conditions can only grow steadily worse, as none of the parties can receive enough support to establish permanent pacification throughout the entire country. The working population shows in many ways that it is absolutely tired of the never-ending strife, but the absence of public spirit and the inability to express public opinion make its desires of little importance to the revolutionary leaders.

As between the various leaders, Villa is a good soldier, and, with a small army under his personal direction, has been generally successful. As soon as he endeavors to undertake administrative work, or military work on a larger scale, his efforts are no longer successful. Carranza, on the other hand, is not a soldier, and while it has not been possible for the State Department in Washington to handle him as satisfactorily as it has Villa, he evidently is a better representative of the Mexican constitutionalist movement. Zapata is of an inferior type to both of the other leaders; he is merely a glorified guerrilla leader without real political purpose.

PANAMA CANAL is making an operating profit. In April, tolls amounted to $442,416. The profit after paying for operation and maintenance was $84,108. From June 30, 1914, to May 1, 1915 the revenue was $3,337,716, and expenditure, $3,377,196.

Accident Prevention by the Steel Corporation

By A. A. WILLOUGHBY

In the article on the Safety, Sanitation, and Welfare Bureau of the United States Steel Corporation which appeared in the Mining and Scientific Press of March 27, 1915, mention was made that the 1914 figures would shortly be available. It is now possible to give these in completed form as a sequel to the article, which was the first to appear in a technical magazine describing the activities and giving the various expenditures of the Bureau.

During the period from January 1, 1911, to January 1, 1915, $24,874,892 was expended by the Bureau under the direction of C. L. Close, its manager. The following table shows by years the various expenditures and the apportionment to the different funds.

	1911.	1912.	1913.	1914.
Relief for men injured and families of men killed	$1,637,000	$2,587,516	$3,013,638	$2,253,901
Accident prevention.	750,000	595,649	660,593	565,334
Sanitation and welfare	1,250,000	1,068,253	1,600,242	615,966
Pension Fund—				535,056
Pension payments	200,000	358,780	422,815	511,967
Additional benefit payments	.....	56,175	43,379	35,621
To permanent fund.	500,000	500,000	500,000	500,000
Allowances to employees under stock subscription plan.	750,000	1,000,000	1,000,000	1,000,000
Totals	$5,287,000	$6,166,373	$7,240,667	$6,017,845

Grand total of $24,711,885.

The percentage of hand-labor accidents to all other accidents by months from April 1913 to March 1915, is of interest: 1913—April, 47.96; May, 46.77; June, 43.93; July, 44.58; August, 47.51; September, 43.83; October, 46.11; November, 45.25; December, 44.54. 1914—January, 42.40; February, 42.69; March, 46.33; April, 44.33; May, 47.34; June, 45.25; July, 45.44; August, 44.65; September, 46.69; October, 46.93; November, 45.12; December, 41.81. 1915—January, 46.21; February, 48.07; March, 48.12%.

Of most interest are the figures showing the percentage of decrease in the accident rate since 1906 per 1000 thousand employees:

	Number saved from serious injury.	Per cent decrease.
1907	532	10.40
1908	783	18.21
1909	1,236	25.28
1910	2,215	43.49
1911	2,012	41.26
1912	2,023	36.06
1913	2,273	38.29
1914	1,748	40.52

Owing to a change made in the reporting of accidents since January 1911, more accidents are classed as serious than formerly, but the decrease is steady; a most favorable showing for the efficiency of the Bureau.

In recapitulation and for purposes of comparison, the classification of causes of accidents in the various lines of industry represented in the Corporation's activities for 1913 and 1914 are herewith given:

	1913, %	1914, %
Hand-labor	43.88	45.04
Railroads	4.22	4.02
Mines	15.10	13.76
Machinery	5.20	4.73
Burns	6.94	6.44
Falls	7.73	8.79
Eyes	...	5.11
All other causes	16.93	12.11

In studying the above it is to be seen that there is little fluctuation from year to year. A perceptible decrease was made in the mine group. The percentage ascribed to mines includes the following:

	1913. %	1914. %
Haulage or skip track	35.23	36.71
Slate, rock, ore, or coal falls—		
From roof	26.62	15.66
From side	16.76	27.14
From face	0.93	1.75
Slides or cave-ins	6.95	5.67
Steam-shovel in open pit	4.11	2.20
Live stock	2.25	3.12
Chutes and raises	0.99	2.20
Gas and smoke explosions	0.73	1.25
Cage accidents	0.53	0.74
Shaft accidents	1.06	1.22
Premature explosions	0.47	0.42
Delayed blasts	0.26	0.06
Blasting operations	3.11	2.46

In this connection it is interesting to note in the classification of causes that accidents due to delayed blasts have been reduced to a negligible quantity. The three leading causes, haulage and skip-track, and falls from roof and from side still holds a large percentage, although the falls from roof showed a healthy decrease during the past year.

Metal output of the Eastern or Appalachian states in 1914 was as follows: mines, 45 gold placer, 36 deep gold, 7 zinc, and 7 copper; gold output, 8397 oz., increase of 380 oz.; silver, 100,727 oz., a decrease of 10,487; copper, 19,555,362 lb., (mainly from Tennessee), an increase of 409,367 lb., lead. 254,000 lb., a large decrease; and spelter, 169,716,954 lb., (mainly from New Jersey and Tennessee) an increase of 8,749,994 pounds.

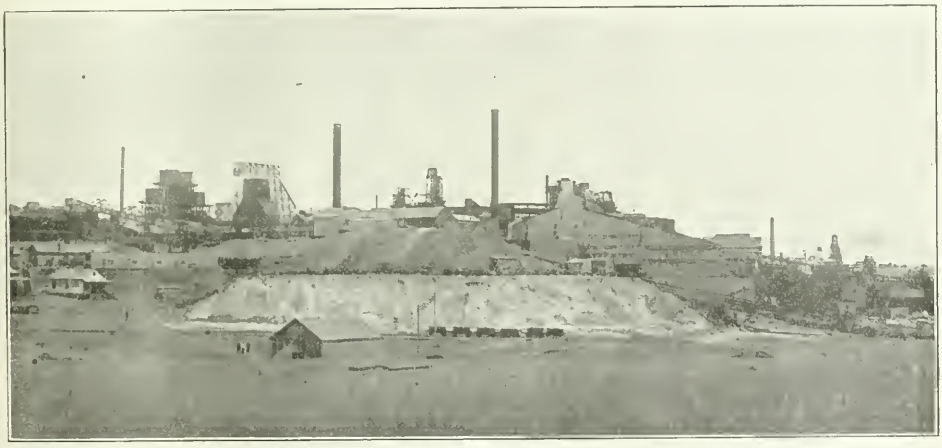
Electric power generated by the plant at Gatun, Canal Zone, in May totaled 2,367,000-kw. hours.

Flotation in Australia

By CHARLES S. GALBRAITH

My first contact with 'oil-flotation' was the reading of an article on Elmore's first patented process in 1899. I was then metallurgist to the Lake George Mines, in New South Wales, endeavoring to make sufficient funds by cyaniding the limonite gossan ore in the upper levels of the Lake George lode in order to extend development into the immense bodies of complex sulphides below the water-level. The intermediate zone—between gossan and dense sulphides—had been successfully smelted in blast-furnaces, but this amenable ore had 'cut out' and the smelter plant was idle. After thorough experiment with the gossan, the fact was established that a small profit could be made, but the quantity of ore available was insufficient to justify the erection of further plant or supply funds for deep development. So a 'close down' was ordered. The sulphide orebody is of a very dense nature with extremely finely divided mineral particles, the gangue being silicious. Blende (representing 14% Zn), galena (representing 5% Pb), and pyrite (representing 1% Cu) were the principal minerals, but gold (2 dwt. per ton) and silver (3 oz. per ton) were the fascinating additions, which, together with the size of the lode, led to so much hard work and money being expended on a solution of the problem. Wet concentration was out of the question owing to the fineness of the mineral grains. The mine went into the hands of a firm of second-hand machinery merchants, and when last I heard of them they were making quite an income from continuing the operations of pumping and precipitating the copper contained in the mine-water with scrap iron, which, alas, abounded on the premises. That this particular ore is amenable to modern flotation treatment seems certain, but in 1900 a sample parcel sent to the Elmore people in England was reported unprofitable, owing to the cost for oil. It will be remembered that Elmore's first process was that of suspension of minerals *in* oil—which has long since been abandoned for the 'greasing' of the mineral particles *with* oil. Lake George ore is one of the many problems of the kind that will be profitably solved—the huge bodies of the Mount Reid and Roseberry districts in Tasmania are others—when the money and the man are available.

Broken Hill is far famed, and the history of the metallurgy of that district is of particular interest. The



THE BROKEN HILL PROPRIETARY MINE AND MILL.

Broken Hill Proprietary mine was discovered about the year 1882 and the original syndicate shares issued at five shillings ($1.20) rose to £420 ($2016) each. In those days, native silver was dug out in tons, and chlorides were easily reduced to the metal. Next came the carbonates (still obtained in some of the leases, notably Block 14 and British) and although this zone was not such a 'gift' as that above, the metallurgical problem was still a 'cinch.' Fortunately for the lucky shareholders the carbonates (rich in lead and silver) lasted for a decade. The third period was marked by the sulphide problem, which will last indefinitely. The upper regions of the unoxidized lode-matter were rich in galena with only a trace of blende, consequently wet concentration was straight-forward; although it must be remembered that modern concentrators did not then exist, and jigs were followed by canvas belts and Frue vanners, etc., later. Today the deeper levels of the mines are rich in blende, while the galena is gradually disappearing. The Proprietary mine and Block 10 are the deepest on the field,

and both are now zinc propositions; in these mining has been for the present practically confined to prospecting work. The presence of rhodonite in the gangue makes both mining and concentration of the comparatively low-grade deep-level ore very difficult and expensive. Rhodonite, a manganese silicate with specific gravity 3.5 and hardness about 7, is exceptionally tough and difficult to crush. It constitutes undoubtedly the worst bugbear to the Broken Hill mill-man. Steel in the stopes refuses to cut it, and crushing machinery 'on top' shirks its work, sliming the mineral particles while it leaves the rhodonite in large grains. Wet concentration consequently is not ideal. Therefore Charles Hylton, formerly mill-superintendent at the Proprietary, was well content to send 54% lead concentrate to his company's smelters at Port Pirie. The 'free milling' ores of the North and South mines—where zinc is low and rhodonite rare—give a better recovery and a higher grade (up to 72% Pb) of concentrate, but these mines are fortunate and are not so deep as the Proprietary.

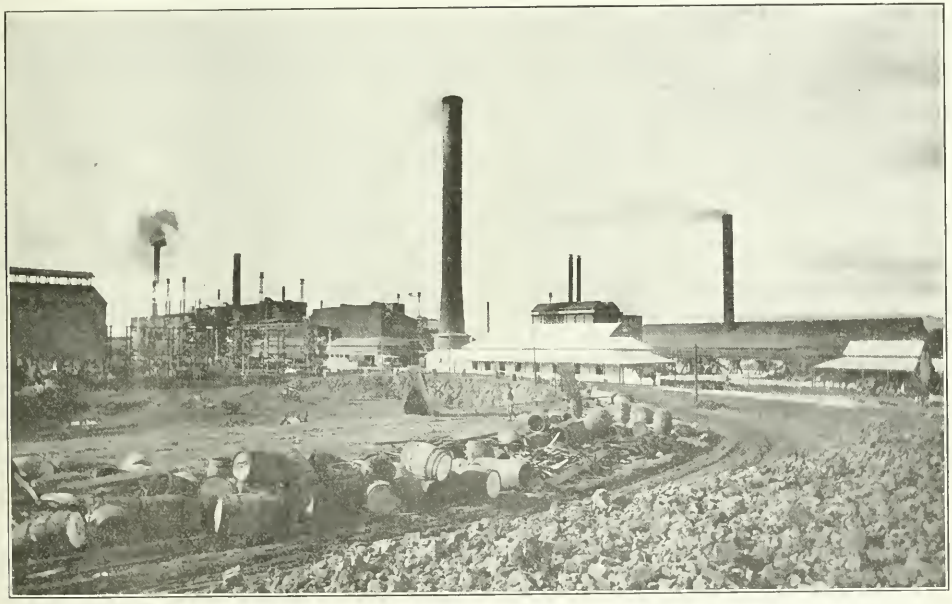
During the lead period, with no means of separating the zinc sulphide, and no market for it, the concentrates consisted wholly of 'lead' (galena averaging about 6% Pb) and the zinc tailings were stacked, pending solution of the 'zinc problem.' There were *some* dumps at Broken Hill. About 1905, experiments having been continuously carried out by various chemists and metallurgists, notably Potter, Delprat, and the Minerals Separation Co., on Broken Hill ores, there was a sudden rush to buy the zinc tailing. Syndicates were formed hurriedly; all available tailing-dumps or 'heaps' and most of the mill-outputs were secured. The zinc era had commenced. Though not the first in the rush, the Zinc Corporation was by far the largest buyer, obtaining both the South mine dumps, and those of Blocks 10 and 14. The North mine dumps and output were secured by the de Bavay Treatment Co., now the Amalgamated Zinc, Ltd., which by arrangement, has also undertaken the treatment of output from both the South and Block 10 mills. The Proprietary has, of course, held on to its own, and was the first to succeed with a practical flotation process, the Delprat. The Central mine, controlled by the Sulphide Corporation, also treats its own tailing and output, by the Minerals Separation process. At the Proprietary mine, the Delprat process was evolved by the company's staff, headed by the general manager, G. D. Delprat, and has been most successful. The Proprietary company, unlike any of the others except the Sulphide Corporation, which smelts its lead concentrate only, ships bullion. It has both lead and zinc smelters of its own, and is indeed so enterprising that it has now erected and is operating the only steel works in Australia, utilizing its Iron Nob ore, in South Australia, which is high in iron and was developed for flux at the lead smelters years ago, so that it can well afford to produce a concentrate of lower grade than these other companies, which, prior to the War, shipped their product to Germany. The penalties imposed by these German smelting works on concentrates of comparatively low zinc-content were so severe that an increase of 1% zinc meant a corresponding increase of about thirty shillings ($7.20) per ton of concentrate. Shipments assaying 47% zinc and over were well sold; those under 45% zinc were a poor product. A sliding scale was recognized by the German buyers, and as no credit was allowed for lead content, the aim of the seller of concentrate was to keep the zinc high, while a domestic smelting company, such as the Proprietary, could be satisfied with a product containing only 40% zinc or under. To see the Delprat units at work even in 1907 was an eye-opener to observers, who, by the way, were numerous and freely invited whereas the equivalent of "fix bayonet, guards" had to be passed before entrance could be obtained to the opposition mills, and in some instances would not be allowed at all. A Delprat unit consisted of a large spitz-box, fed continuously by an automatic 'push eccentric' feeder, the falling (dry) pulp meeting an upward stream of hot salt-cake solution (acid), the mineral was 'elevated' (while the gangue 'dropped'), and floated with the overflow into the collecting launder. The tailing was released from the bottom of the 'spitz' intermittently (as it accumulated, and so as to save loss of solution) upon a 12-in. belt-conveyor, and thence carried to a 'pass' for mine-filling. The concentrate-launders discharged into bins, with drainage-bottoms and the liquor was pumped back, to be made up to the required strength by the addition of salt-cake. Each unit or 'spitz' has a capacity of 20 tons ('long') per hour. 'Output,' 'economy,' and 'profit earning' were all so obvious that the freely confessed low concentrate did not worry the thoughtful onlooker or diminish his admiration.

While the 'Delprat' was operating successfully in 1906-1907, other processes at Broken Hill were under experiment, to be scorned and ridiculed in turn, particularly the plant to which I had just been appointed manager, the Amalgamated Zinc. The Zinc Corporation was in 'some state,' and varied both process and management about once per month. Spelter was high, $105 per ton—as was lead also. A boom was on. Shareholders argued that if the 'Delprat' was a success, and the 'Minerals Separation,' also why then couldn't the de Bavay, Zinc Corporation, and other companies get on the dividend list and obtain the advantage of the boom prices? Hysteria reigned, and it was not until that was cured, probably in the case of the Zinc Corporation by H. C. Hoover and W. J. Loring, that a solution was found. It must have taken excellent and influential finance to save the Zinc Corporation from entire collapse, and, although the cost was tremendous "more power to those responsible for the present happy result." In a smaller degree the Amalgamated Zinc Co. (de Bavay's) had its hysterical period, but strong financiers held the controlling interest in this case, and the small holders were kept quiet. M. de Bavay, a Frenchman who has occupied the position of chemist to the Foster Brewing Co., Melbourne, for many years, and who is also a *vigneron* in Victoria, entered the lists of flotation patentees in a peculiar way. When the Potter *v.* Delprat litigation commenced—Potter being another brewer—they called in de Bavay as an expert chemical witness. Potter's argument was that the acidulated solutions, when

in contact with the pulp, generated H_2S and H by partial decomposition of the mineral grains. Delprat, on the other hand, insisted that the solutions generated CO_2 by action on the carbonates of the gangue. M. de Bavay would not allow the latter argument and in order to prove to himself that CO_2 was not generated, he performed the following experiment in his own laboratory. A small quantity of ground pulp was submitted to treatment by carbonic acid gas in order to remove all trace of carbonates. The intention was subsequently to treat the residue with acid solution in order to prove the chemist's contention. However, the intention was forgotten *ad interim* when a surprising result—one of those accidental discoveries so often seen when a different object is in view—occurred. "When the contents of the receptacle were emptied into a beaker, a thick clean layer of 'black jack' sprang to the surface of the liquid, while the white clean gangue was precipitated to the bottom." Those are essentially M. de Bavay's descriptive words, to me, on his discovery. He commented: "Well, I knew if I could put that into practical application I had a pretty good thing." So he developed a flotation process with carbonic acid as the essential reagent, and later the first de Bavay plant at the North mine, Broken Hill, was established on those lines! Commercially it was a failure, and when in 1907 I commenced pulling down the retorts, the old man was quite affected; but as the space was required, they had to go. He had substituted the 'universal' combination of acid and oil, and had his patents with the rest. His way of treatment varies from the others—they all vary a little—but acid and oil are the essentials, and the Judge who has the decision of "who has prior rights to a patent in a flotation process" has my sympathy. So much is problematical. Delprat—whose experiments were practically contemporary with those of Potter, but quite independent—won the suit in the Civil Court. Delprat had gone further than Potter and established a commercial process. Potter had not gone beyond the laboratory. Potter appealed to the High Court, however, and the Broken Hill Proprietary company settled the case by payment to the Potter Treatment Co. of £10,000 and forming an amalgamation between the companies negotiating both patents.

The Potter company successfully defended an objection to amendments in reference to their patents by the Minerals Separation, Ltd., in June, 1909, before the High Court of Australia; and the Potter patents are duly recognized and established in Australia. Unfortunately the inventor—as is also usual—got nothing out of all his work, worry, and brain power. Charles V. Potter was still a poor man, when he died, no doubt poorer both financially and spiritually than prior to his great invention.

However, in this world a man who invents a process is 'looking for trouble' and when, not having engineering knowledge of his own, he persists in doing the engineering development of his chemical results, he is making trouble both for himself and his backers. The astonishing thing is that these latter, generally hard astute business men, allow such a course. To hark back to the de Bavay 'movement.' It took quite three years, and an expenditure of about £80,000 (the company admitted £65,000) to get through the experimental stages. And



THE PORT PIRIE SMELTER, SOUTH AUSTRALIA.

it was only when the inventor was 'put aside' and the management allowed to 'get to work' that success—so obvious so much earlier to engineers—was achieved. Further, the 'tables' that were finally adopted 'cone-shaped' were condemned by the inventor in 1907. This is an amusing point to me, for I tried so hard to introduce the 'cone tables,' to overcome the absurd system of mechanical beaters then in use, that would not run a day without breaking down. The principles of de Bavay's process are

1. Friction to clean mechanically the particles of mineral, particularly in weathered material.

2. Treatment with sulphuric acid with heavy agitation to remove the oxidation skin.

3. Subsequent double washing, with agitation, to remove insoluble sulphates resulting from acid treatment.

4. Oiling with agitation, so that all mineral particles obtain a film of oil on their entire surfaces.

5. Aeration, partly in an agitator with oil, and subsequently by 'beaters' and on transit over tables (now conical and corrugated) in a thin pulp-flow with water.

6. Increase of surface tension by addition of a small quantity of emulsified oil (colza oil used to be employed), water-borne, just prior to the pulp flowing onto the tables. The concentrate floats over on the overflow of spitz-boxes, into which the tables dip. A series of four tables is sufficient to 'clean' the tailing.

The process is 'tedious' but it is a true flotation, involving no frothing, and no uplifting gas-bubbles as in the Potter and other methods. I understand de Bavay patents are now combined with those of the Minerals Separation and T. J. Hoover, in his excellent work on the subject ('Concentrating Ores by Flotation,' 1912) prophesies that not much will be heard of it in future.

Personally, I have a great regard for this process, used judicially and perhaps in combination with other methods. The great advantage is the high grade of the concentrate. This is all important where shipment of the product is essential, a large saving in freight being effected. The Amalgamated Zinc Co.'s concentrates assay up to 48.5% zinc quite regularly and in 1907 I shipped parcels of 48.9 and 49.1% zinc. The disadvantages are increased cost of operation, and the fact that slime is not amenable to this process, so far as trials have gone.

Slime is the mill-man's *bete noir* in all operations of concentration. For chemical processes they are 'the thing.' Perhaps a combination of flotation and lixiviation may be the future 'way out.'

In conclusion a few remarks on 'oils' may be of advantage. Much has been written on the use and efficacy of oils, but, even at the risk of being considered 'heathen,' I am emphatically of opinion that any particular oil for each particular ore is 'bunkum'! Oil is a means to the end, not the end. At the North Mine plant expensive 'valve' oil was used, costing about 90c. per gallon, and three months later 'truck' oil at 25c. per gallon gave equally good results! Both the above were mineral oils, but subsequently crude 'eucalyptus' oil (distilled) from the leaves of the indigenous eucalyptus (those wonderful trees that supply the strongest constructional timber in the world) has been used in Australia with great success. Refined eucalyptus oil—used medicinally with good effect for strains, rheumatism etc, and internally for colds—is expensive. But I judge crude eucalyptus oil for flotation processes could be imported quite cheaply from Australia, if the demand was sufficient. However, with proper judgment, good plant design, and legitimate experiment, I consider that success can be obtained in most cases in the treatment of sulphide ores without any great worry as to the kind of oil to be employed.

Manjack

In outward form and general appearance manjack is not unlike fine coal and is essentially a bituminous substance. It is an oil residuum occurring in lenticular seams between walls of peculiar clay, which appear to have absorbed the oil under very heavy pressure. It is jet black in color and resinous in its nature and has long been known for its insulating properties in the manufacture of electric coils, dynamos, and generators. In the island of Trinidad there are large deposits of manjack, especially in the San Fernando district, where are the Vistabella and the Marabella properties. During the past decade 18,000 tons was exported in a crude state.

The Vistabella manjack properties are worked under a long lease by an American company, which, besides exploiting and exporting manjack in its natural state, has undertaken the manufacture of certain well-defined compounds. One of these is a high-grade black manjack paint for use on smokestacks and on boilers, both inside and out; another is a preparation suitable for greasing pipe-threads, dressing wire-rope, etc.

Chester W. Martin, U. S. Consul at Georgetown, submitted in 1913 a lengthy report on the mineral resources of Barbados, British West Indies, in the course of which he said, relative to manjack:

"Manjack has been known to exist in the island almost from the first settlement, and a governor's report, dated 1676, states: 'There is a kind of metal much resembling cannel coal in Lancashire, called 'moniak,' with which sugar is boiled.' The surface outcrops have been frequently dug and used as fuel on sugar estates in the district in which it is found, but no systematic attempt was made to mine it until 1895. Starting with the idea of mining a cheap fuel, those so engaged were not long in finding that some of the mineral sold to the railway company as fuel was an almost pure bitumen of great value to the paint and varnish trades. Since that time the working of the mines has been continuous to the extent of supplying the demand for export.

"Barbados manjack is of two varieties, the conchoidal and the columnar. The first is the more valuable, and a newly fractured specimen cannot be distinguished from jet, so far as outward appearance is concerned."

The cargoes of manjack invoiced at the Georgetown consulate for shipment to the United States in 1914 amounted to 59 tons, with a declared value of $6159, against 112 tons, valued at $9435, in 1913.—*Daily Commerce Reports.*

Notes on Homestake Metallurgy

By ALLAN J. CLARK

*Introductory. The mineralized slate and schist that constitute the ore vary considerably in composition, but the unoxidized ore, constituting the major part of the reserves, contains either chlorite or hornblende, with quartz, carbonates of lime, magnesia and iron, and arsenopyrite, pyrite, and pyrrhotite. Ferrous minerals predominate and this fact has been an important factor in determining the metallurgical treatment.

With one or two exceptions the minerals noted are of relatively high specific gravity, and the ore as a whole is exceptionally heavy, many determinations giving an average specific gravity of 3. This high specific gravity presents one decided advantage, when the cost of treatment is compared with operations elsewhere, in that the ton, almost universally the basic unit, represents a volume probably less by 10% than that of many gold ores. On the other hand, this high gravity renders more difficult the discharge of pulp from mortars, its distribution on amalgam tables, and its transportation in launders.

In the same way, as attesting the usual balance of such variations of different ores, it may be noted that the needlelike fibres of hornblende (cummingtonite), interlacing throughout the mass, render the ore more difficult to crush, but on the other hand assist in maintaining free leaching in both sand and slime treatment, retaining their characteristic form as far as they can be traced with the microscope.

The metallurgical equipment consists of:

At the South Side:
- 3 stamp-mills (660 stamps) with 36,356 sq. ft. of amalgam plates.
- 1 re-grinding plant, with independent cone system and 540 sq. ft. of amalgam plates.
- 4 batteries of cones for classification.
- 3 clarifying-tank houses.
- 1 sand-plant.

At the North Side:
- 2 stamp-mills (360 stamps).
- 2 tank-houses.
- 2 cone-houses.
- 1 sand-plant.

At Deadwood:
- 1 slime-plant, treating the combined slime from South and North sides.

A flow-sheet is given in Fig. 1.

The ore supplied to the North Side mills is usually drawn from the upper levels of the mine, and is at least partly oxidized. It is more easily penetrated by cyanide solutions than is the unoxidized ore, and satisfactory extractions are at present made from the sandy portion of the mill-tailing without further reduction in tube-mills.

*Abstract from paper to be presented at the September meeting of the American Institute of Mining Engineers, San Francisco.

Stamp-Milling. The stamps, when newly shod, weigh 900 lb. and drop 10 in., making 88 drops per minute. Pulp discharges through No. 8 diagonal needle-slot screens. Inside amalgamation is practised, quicksilver being fed to the mortar, and a copper chuck-bolt, about 5½ in. wide, being placed inside the mortar, below the screen. To facilitate discharge and distribution of the pulp over the amalgam plates, water is liberally used, the usual ratio being from 10 to 11 parts, by weight, to one of solids.

Electric drive, now in use for more than two years,

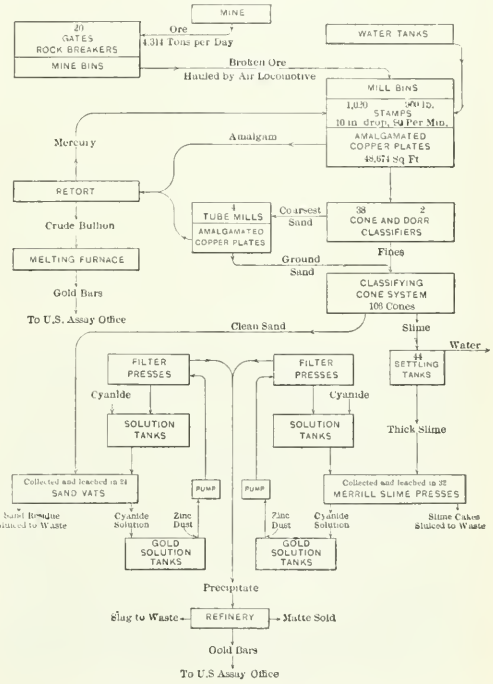


Fig. 1. Flow-sheet of Homestake Mill.

permits more nearly continuous operation than formerly. A 25-hp. back-geared motor drives each 10 stamps, transmitting motion by a 16-in. belt.

Chuck-blocks are cleaned in rotation, the usual interval between cleanings being about two weeks; outside plates, except those of the fourth row, are cleaned and dressed daily. Fourth-row plates are dressed at intervals of two days. At the foot of the rows of plates are traps, from which the sand is removed every second or third day. This trap-sand is run over a special silvered amalgam plate, the tailing rejoining the main stream of tailing. It was formerly the practice to clean these traps

daily, but this is not necessary since the development of the re-grinding plant, which acts, in effect, as a large trap for all the mills.

Amalgam is retorted three times each month. Oil-fired retorts are used, the resulting bullion being melted in coke-fired furnaces. The loss of quicksilver in retorting is almost *nil;* the subsequent melting loss, which averages slightly more than 1% of the weight of the crude bullion, includes some quicksilver not driven off in the retorts.

The unoxidized ore, although carrying large quantities of sulphides, amalgamates well, but not so freely as old records show to have been the case in earlier years, when less of this class of ore came to the mills. A longer time is apparently required to properly incorporate the quicksilver with the pulp, and the resulting amalgam is recovered somewhat farther from the battery. The results given in Table I illustrate this tendency.

TABLE I.—COMPARISON OF AMALGAMATION RESULTS ON ORES OF DIFFERENT PERCENTAGES OF SULPHIDES

Column I. All mills, three-month period in 1910.

Column II. One mill, crushing unoxidized ore exclusively, three months, 1915.

Of the total extraction by amalgamation, there was recovered from:	I. %	Cumulative. %	II. %	Cumulative. %
Batteries	49.4	49.4	35.6	35.6
First-row plates	37.5	86.9	42.9	78.5
Second-row plates	4.4	91.3	8.1	86.6
Third-row plates	2.3	93.6	3.5	90.1
*Fourth-row plates	0.9	94.5	2.0	92.1
Skimmings	4.0	98.5	6.9	99.0
Trap-sand	1.5	100.0	1.0	100.0
Percentage of ore-value..	...	71.7	...	69.7

*Only two mills (440 stamps) equipped with a fourth row of plates.

The 'skimmings' are recovered from re-treatment of the foul amalgam, sulphide particles, etc., removed from the clean-up sink during the clean-up of the chuck-block and plate amalgam.

These cleanings are re-treated with an excess of mercury in a small barrel 24 in. diam. by 302 in. long, in which iron balls or pebbles are placed, the mineral particles being ground and the amalgam recovered. The rejected sulphides, carrying perhaps $1000 per ton in gold, are briquetted with water-glass and charged to the blast-furnace, when smelting cyanide precipitate or by-products.

The increased proportion of the amalgam recovered from the skimmings during the second period under review is a natural result of the increased percentage of sulphide particles in the ore. The tendency of fine sulphides to collect in the slight depressions in the surface of an amalgamated plate is well illustrated at the re-grinding mill, where it is necessary to wash such a film from the surface several times each day.

It is perhaps not customary to report inquiries that have failed of definite conclusions. The following notes of such an investigation are not without interest, despite the lack of decisive result. Records of all six mills were tabulated over a period of one year, in an effort to determine what relation, if any, existed between the amount of quicksilver fed to the batteries, the amount of bullion recovered, and the grade of the ore crushed. As was to be expected, individual determinations varied considerably from the average, but for four of the mills, and these fortunately including those crushing ore of the two extremes in value, the points coincide reasonably well with a curve represented by the equation

$$T = \frac{8.5\,B\text{-}H}{H}$$

when

T = Value of ore (dollars per ton).

H = Troy ounces of quicksilver fed to batteries.

B = Troy ounces crude bullion ($16 per oz.) recovered.

Of the two remaining mills, one was crushing surface ores with comparatively coarse particles of free gold. This, not unreasonably, showed values for H about 10% below the values indicated by the equation. The sixth mill gave results nearly 20% higher than might have been expected. This mill, on account of an insufficient supply of water, crushed nearly 10% less ore than the average, and it is conceivable that the longer retention of the material in the battery caused undue flouring of the quicksilver. It is more probable, however, that the explanation is to be found in the personal equation of the millman in charge.

The crushing units are not in conformity with modern ideas, and there is no doubt that, were the plants to be built anew, radical changes in design would be made. The Homestake, unlike many younger mines, has developed gradually from comparatively small beginnings. The mills represent the growth of 30 years. Built before the cyanide process was known, they then represented advanced milling practice. It must be conceded that the stamp duty of 4½ tons, with 80% of the tailing passing a 100-mesh screen and 60% passing a 200-mesh screen, is fairly good even when compared with the results reported from many newer installations.

We find that heavier stamps crush more rock, with little or no change in the sizing of the tailing unless more open screens are used; in which case, even without increasing the falling weight, tonnage may be gained at the sacrifice of fineness. To us it appears that compactness of plant, with the saving both in first cost and, later, in labor and supervision, constitutes the leading claim of the heavy stamp for preferment. Indeed, if the gold metallurgist is ready to dispense with amalgamation—and we are by no means prepared to do this—it is more than probable that he will do well to investigate the crushing practice of modern copper-mills before he commits himself to the heavy gravity-stamp. Alaska, at the moment, holds more of interest than does Africa.

It may be pertinent to note that I have never encountered a Homestake mill-tailing, no matter how far advanced in secondary treatment, from which some free gold could not be recovered by laboratory amalgamation tests.

RE-GRINDING. Operations at the re-grinding plant offer little of interest, the practice conforming closely to the usual methods.

The feed to the tube-mill is already so fine (only 25% remains on a 50-mesh screen) that the efficiency of the mills is low. The critical size of sand delivered to the sand-plants is about 100 mesh for unoxidized ore, and 80 mesh for oxidized. It is advantageous to operate the mills in closed circuit, but it is difficult to do this without permitting sulphide particles that have been sufficiently reduced in size to remain in the circuit. By introducing a double baffle or trough-classifier, containing a hydraulic device, into the slime-overflow end of a Dorr classifier this difficulty has been in a measure overcome, and two of the mills are at present using this system. The accompanying table of tube-mill data has been compiled from earlier records, when none of the tube-mill discharge was returned for further grinding.

THE HOMESTAKE MILLS, AT LEAD, SOUTH DAKOTA.

Each mill discharges its tailing over an amalgam table, and about 40 cents is recovered per ton ground.

RE-GRINDING PLANT DATA

Mill number	1	2	3	4
Manufacturer	Denver Eng. Works	Allis-Chalmers Co.	Allis-Chalmers Co.	Hardinge Conical Mill Co.
Dimensions, feet	5 by 14	5 by 18	5 by 18	6 by 6
Speed, rev. per min.	27.0	28.5	28.0	26.5
Actual horse-power (motor input)	32.0	42.0	42.0	27.0
Fed from	Dewatering cone	Dorr classifier	Dorr classifier	Dewatering cone
Tons fed per day	98.0	138.0	133.0	93.0
Pebbles per ton	1.40	1.24	1.38	1.71
Tons to pass 100 mesh	41.0	52.0	49.0	34.0
Tons to pass 100 mesh per horse-power	1.28	1.24	1.17	1.26

RE-GRINDING PLANT OPERATING COSTS FOR 1914

	Cost per ton fed to tube-mills.	Cost per ton reduced to pass 100-mesh sieve.
Labor	$0.0496	$0.1289
Pebbles and liners	0.0259	0.0673
Renewals, mills, and cones	0.0074	0.0193
Machine-shop service	0.0037	0.0096
Silver-plating	0.0077	0.0200
Sundries	0.0029	0.0075
Power	0.0292	0.0759
Total	$0.1264	$0.3285

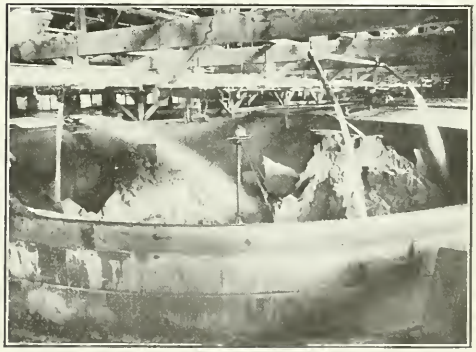
Tons fed to mills, 152,106. Tons ground to pass 100-mesh sieve, 58,605. Cost of re-grinding, per ton crushed in stamp-mills, $0.0121.

SAND-TREATMENT. The sand is leached with cyanide solution in vats 44 ft. diam. by 9 ft. deep, holding 610 tons of sand each. The operations are distinguished by unusual care in the preparation of the material for extraction, rather than in the extraction itself.

Classification and aeration are the two essentials to successful work. The latter, necessary to overcome the tendency of the ferrous compounds in the ore to remove the vital oxygen from the solutions, is achieved by forcing, at intervals, air under slight pressure into the false bottom, below the filter-canvas. The charge is suitably drained before this air is applied; the pressure is so adjusted that the air is forced into the sand, yet is so low that the column of sand is nowhere broken or disturbed. To secure this immunity thorough classification is essential, and this has always been recognized as a matter of first importance.

Four batteries of cones, each fed from the discharge of the preceding set, the first three sets acting by gravity alone, the last assisted by a hydraulic connection, deliver a clean sand to the vats. As a further precaution, the vat is filled with water before sand is turned into it, so that a constant overflow is maintained during filling and a final separation of slime particles added to the sum of the cone separations. As a matter of fact, the sand is so clean when it enters the vat that this final step is not one of strict necessity, but we have found that a charge filled in this manner is in a less compacted condition, presumably easier to leach and certainly easier to discharge.

The action of the air is interesting. Laboratory tests



SLUICING THE BIG SAND-VATS.

indicate that, on an average, about 75 cu. ft. of oxygen is absorbed by a ton of ore, before its reducing action is corrected. If this air is not supplied from some extraneous source, the solutions are vitiated and extraction ceases. When air is applied and is followed by a water wash, calcium thiosulphate appears in the effluent solutions; when the air is followed by cyanide, the effluents contain sulphocyanides and free cyanide appears only after some time. After a limited time of leaching, the extractive power of the solution decreases and further aeration of the charge is necessary. Each aeration is

attended by the formation of some acid and the consequent destruction of some lime and cyanide. After treatment, the sand shows no sign of oxidation; neither analytical nor microscopic examination can detect difference between charge and residue.

Lime, crushed in a one-stamp mill to pass a 7-mesh screen, is added to the pulp stream as it flows to the vat. Regulation is by weighing a prescribed amount of lime into the automatic stamp feeder at 2-hr. intervals. The choice of screen is determined by the rate at which the lime slakes, the intent being to exhaust the particles only when treatment is completed. Formerly small quantities of lime were added to the top of charges during the drainage periods, to supplement that fed with the sand, but this is no longer considered to be necessary and is not done except in emergencies.

It had long been recognized that a high protective alkalinity was detrimental, but until within the past two years it had been tacitly accepted that it would be impossible to dispense entirely with protective alkali. Eventually this was done; extractions improved and consumption of cyanide was materially reduced.

The gratifying results are in a measure due to another change in procedure, initiated at about the same time. Reference to the treatment chart will show that solutions of two strengths are used; that stronger in cyanide is used earliest in the treatment of a charge. When these solutions appear as effluents, one portion is precipitated, the other brought to full working strength by adding cyanide and thereafter returned to the extraction of another charge of sand.

This custom is by no means unusual, yet wherever it is used the procedure seems to be to maintain the stronger solution at a fixed content of cyanide and to allow the weaker to vary in strength according as the varying losses in treatment may determine. This is wrong in principle. The critical strength is that below which the weaker solution will no longer dissolve its quota of gold, or, if dissolving it, will no longer freely yield it to precipitation. If the strength is greater than this, we may confidently expect some cyanide to be destroyed without giving compensatory service. In such circumstances, if the maximum working strength is reduced, the weaker solution will be automatically restored to the lowest economic strength; if it falls below this, a temporary increase in the maximum strength will restore it. In other words, cyanide should be added to the *strong* solution in accord with the determinations of strength made on the *weak* solutions. Thus, operating with a strong solution of variable strength and a weak solution also variable, but never far from its effective limit, it may be anticipated that little cyanide will be needlessly expended in this way.

Slime-Treatment. The slime-plant is equipped with 30 Merrill presses, each of 90 frames, 4 by 6 ft. by 4 in. One press holds 26 tons of slime, and has a capacity of about 70 tons a day.

The entire treatment is given in the presses, which successfully meet the conditions for which they were designed, holding a tight and homogeneous cake during aeration periods (which impose a most exacting requirement on the machine) and discharging readily without requiring manual labor. In this connection it may be mentioned that all the operations incident to the filling, aeration, leaching, washing, and discharging of 30 presses—totaling about 75 charges daily—are conducted by three men on each shift. The actual time required by one of these men in the performance of every step in the treatment of a charge is slightly less than 15 minutes.

Treatment is in principle identical with that of the sand, periods of aeration and treatment alternating with sufficient frequency to maintain the activity of the solutions. The alkalinity is carried at a very low point, but the working solutions are of low cyanide strength, as reference to the charts will show. Within the restrictions imposed by practice, there seems to be no solution so weak that it will not freely extract gold from the aerated slime. The problem seems to demand the passing of a definite volume of solution through the slime-cake, rather than treating with solution of a definite strength or for a definite time. So long as this amount of solution is passed, the extraction is accomplished. Thus the treatment time is a function of the leaching rate.

The minimum working strength is determined by our ability to precipitate the effluent solution, and in developing this minimum much of the treatment is given with very dilute solutions, with the result that the consumption of cyanide has been reduced to an extremely low figure. For instance, a 10-day period, concluding as this is written, gives the sodium cyanide (128%) consumed per ton of slime treated: In treatment, 0.127; added for precipitation, 0.008; making a total of only 0.135 pound.

The precipitation of the 'low solution' (first and final effluents, low in both gold and cyanide) is difficult; doubly so on account of the low alkalinity; and after trial of many expedients to assist it we are not able to improve upon Carter's old system of a drip of strong solution.

This, usually added with the feed of zinc-dust at the rate of 1 lb. per hour (or per 25 tons of solution precipitated) constitutes from 5 to 10% of the cyanide used. An excessive amount of zinc-dust is also necessary to insure clean precipitation of these solutions, and this entails further expense, not merely in the first cost of the zinc, but in the refining of the larger bulk of low-grade precipitate. Combined, these costs consume about 25% of the profit won through the reduction of cyanide consumption, a satisfactory enough result in a plant where treatment methods have been so well established as is the case here, even though the impression may be conveyed that one branch of the work has lost efficiency.

Some assistance in this precipitation difficulty is received through the application of this barren low solution as a preliminary wash.

Double cloths are used on the presses, the lighter one being in contact with the frame. This is unbleached muslin twill, and is in turn covered with cloth of No. 10 canvas duck. Joints are made with Thermalite paint.

During the early days of the plant, when the equip-

ment was not equal in capacity to the tonnage of available slime, a suit of cloths was used for as much as 30 months, it being preferable to lose slime rather than to stop to repair leaks. It should be remembered that the arrangements of ports and channels in the presses is such that treatment may be given in either direction, so that a single leak would in no wise affect treatment, but would merely entail the wasting from the plant of a certain amount of untreated slime. At this time, as much as 500 tons was wasted in a month. As the plant has been brought to full capacity, the cloths have been renewed, first after 18 months' service, now after 16 months'; the leakage loss on the latter basis has been brought to an average of less than 40 tons monthly over an entire year, with a minimum of 8 tons in a single month. This in treating a total output tonnage of more than 58,000 tons of pulp.

Precipitation. The Merrill system of precipitation with zinc-dust is used at all cyanide plants, as is the Merrill filter-press of triangular section. This method has been fully discussed,* and the technique remains about as there described. It has been mentioned that the effect of the recent variations in treatment has been adverse to precipitation, since the tonnage of solution requiring precipitation has been increased at the same time that the content of solution in gold and cyanide has been reduced. Beyond the natural effects—increased zinc consumption and lower-grade precipitate—no difficulties have been encountered.

Double cloths are used on the frames, the outer one being taken off when the press is cleaned and replaced by the inner cloth, which is in turn replaced by a new cloth. The outer cloth is burned, the ash going to refining. Experiments are still in progress to find the lightest and cheapest cloth that can be used for this purpose without unduly increasing the hazard of leakage. All washing of cloths is eliminated by this system. Against the added cost of cloth may be set the advantage of security from leaks due to rotten or wrinkled cloths and the labor of washing soiled cloths.

Refining. In its essentials, this remains as described in the earlier paper, except that after acid treatment of the lower-grade precipitate, the briquettes are charged to the blast-furnace instead of being fused in the cupel. The latter treatment is still the standard for precipitate of higher grade.

Acid-treatment is a preliminary to furnace-treatment of all precipitates. It may not be necessary, but in my judgment it is sound metallurgy, since it enhances security from stack losses and insures more fluid slags. Moreover, the decreased bulk of product to be smelted with lead decreases the time required for that operation, always more or less hazardous to the health of the workmen.

Oil is now used as a fuel in the cupel furnace, replacing wood. It is an ideal fuel for the purpose, and its use has resulted in an acceleration of nearly 50% in the rate of cupeling.

*Trans. Inst. M. & M. Vol. XXII, page 68.

Flotation at Broken Hill

According to the annual report of the Zinc Corporation, recently issued, the following results were obtained: Operations were suspended for four months owing to the War. The company treats tailing from other mining companies, also ore from its own mine, the South Blocks.

The lead concentrator treated 141,667 tons of ore of an average assay-value of 14.4% lead, 2.6 oz. silver, and 9.3% zinc. This produced 26,567 tons of lead concentrate assaying 64.6% lead, 9.2 oz. silver, and 6.45% zinc; and 34,317 tons of zinc middling assaying 15.8% zinc, 1.6 oz. silver, and 4.9% lead. The cost at this plant was $1.13 per ton.

The zinc concentrator treated 221,620 tons of tailings assaying 13.68% zinc, 6.42 oz. silver, and 5.93% lead. Of this, 169,180 tons was from dumps, the remainder being ore from the British and Junction mines, and the company's own lead concentrator mentioned above. This yielded 63,300 tons of flotation concentrate assaying 43.96% zinc, 13.91 oz. silver, and 13% lead. The retreatment of this product, by tabling and the Horwood process combined, yielded

	Tons.	Zinc, %	Silver, oz.	Lead, %
Zinc concentrate	48,325	46.77	10.58	7.64
Horwood zinc concentrate	3,986	48.17	15.16	6.47
Lead concentrate	7,469	15.69	32.84	54.56
Horwood lead concentrate	1,688	14.63	38.01	35.48

In addition to the above, 1362 tons of zinc slime was produced, assaying 37% zinc, 18.42 oz. silver, and 13.43% lead.

The Horwood process plant treated 6144 tons of zinc slime direct from the zinc concentrator and 3169 tons from the accumulated dumps for a return of

	Tons.	Zinc, %	Silver, oz.	Lead, %
Zinc concentrate	5,882	48.1	16.90	6.80
Lead concentrate	2,619	14.0	40.52	35.55

The cost at this plant was 30 cents per ton. The enhancement in profit due to treatment by the Horwood process amounted to $1.72 per ton of zinc slime.

The sulphuric acid plant worked steadily at full capacity and made 2914 tons of acid. Working costs averaged $2.50 per ton, the Horwood* process being responsible for 30c. per ton of this total. The estimated amount in the dumps still remaining to be treated is 1,522,074 tons.

Material dredged at Panama in May amounted to 1,092,637 cu. yd. Of this, 671,149 yd. was from the Gaillard (Culebra) cut.

*The principle of the Horwood process, according to Hoover, in 'Concentrating Ores by Flotation,' is that when a mixture of iron, copper, lead, and zinc sulphides is roasted, the surfaces of the particles of the three former sulphides are changed to oxide and sulphate at a comparatively low temperature, whereas the zinc sulphide is practically unaltered. The partly-roasted material is then subjected to a heated-acid oil-flotation process, when the zinc sulphides will float away, and the deadened or sulphated compounds of iron and lead will sink with the gangue.

A Mine-Owning Tribe of Indians

By LUCIUS L. WITTICH

Members of the Quapaw tribe of Indians in Ottawa county, northeastern Oklahoma, are, almost to a man—and squaw also—firm believers that "a bird in the hand is worth two in the bush," which explains the recent decision of the Supreme Court of the United States, which has decreed that the Quapaws shall no longer have the privilege of selling their royalty rights on the zinc and lead lands they own.

About ten years ago zinc and lead ores were found in abundance on the Indian tracts and since then some of the most productive mines in the entire Missouri-Kansas-Oklahoma district have been developed on these lands. In this district there are about 24 different camps, producing in all about $18,000,000 worth of ore annually, and it is interesting to note that the northeastern Oklahoma district now ranks third among the list of producers with a yearly ore output valued at $2,000,000. By an act of Congress in 1897 the Indians were permitted to lease their lands for mining purposes for a period of 10 years, but at that time no mines of importance had been opened. It was about eight years later that the first big mines were developed north of Miami, Oklahoma. The operators would procure leases from the Indians, agreeing to give them 5% of the money received from the sale of ore; at this juncture the speculator would appear upon the scene and purchase the Indian's right to whatever royalty money might accrue. The assignment of such royalties would be duly printed in legal form in some newspaper and presumably the transaction was in accordance with law.

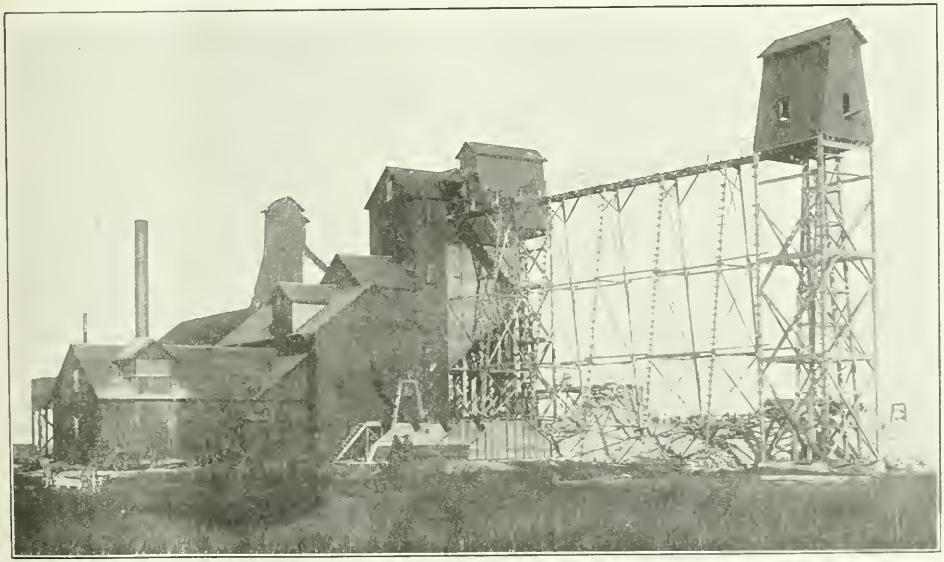
In the early days of royalty-selling the Indian's right would be transferred for an absurdly small sum. When a speculator learned that a rich drill-strike had been made on a certain piece of land he would go to the Indian land-owner and endeavor to show him—and usually with success—wherein he could be benefited by disposing of an uncertainty for a certainty, the latter being some specified sum of money, usually not more than two or three hundred dollars, and sometimes as low as $25. As an illustration, a state official of Oklahoma, some years ago, purchased for $250 the royalty rights on the land of Wah-tah-noh-zhe, a squaw, the lease of which land was held by the Miami Royalty Co., which had agreed to give the squaw a 5% royalty. By the assignment of the royalty rights the proceeds would go to the state official instead of to Wah-tah-noh-zhe, but to the latter the $250 in hand was a much safer bet than the slim chance of ever getting such a vast sum out of the mineral that might be produced from her property. Besides, that was in the early days of development and big mines were yet to be a thing of the future. But it chanced that on Wah-tah-noh-zhe's land the famous Turkey Fat mine was opened and the royalty already received by the Oklahoma politician who purchased the squaw's royalty rights has exceeded $100,000. By the recent decision of the Supreme Court, which reversed the decision of the lower courts, Wah-tah-noh-zhe will not only be entitled to the royalties henceforth—and the Turkey Fat is still a big producer—but the way is opened to her to bring suit for the recovery of the royalties paid over to the Oklahoman during the past several years.

Scores of similar instances, on a smaller scale, might be mentioned. In the more recent transactions, however, the price of the royalty assignment has begun to grow. Meh-hunk-a-zhe-ka Beaver, a squaw, sold for $1200 to a speculator at Baxter Springs, Kansas, her royalty rights on the land where the Ortt & Buchanan Mining Co. is now opening a large lead-producing property. Meh-hunk-a-zhe-ka Beaver received her $1200 in cold cash and possibly has spent it by this time. Just where the purchaser of the royalty rights gets a run for his money in this instance it is hard to determine, as he had not yet begun to receive the royalties that he had purchased when the Supreme Court's decision knocked his cleverly-laid plans into a cocked hat. Will Meh-hunk-a-zhe-ka Beaver be required to return the $1200? The purchaser of her royalty rights is worrying more about the answer to this question than anyone else.

The Quapaws are the most uncivilized and the wealthiest Indians in Oklahoma; yet they are the only tribe of Indians in the United States who do not have to submit to the Secretary of the Interior, for his approval, their plans for the disposal of their land. This condition was the result of a lobby at Washington lead by ex-Governor Crawford, of Kansas. He was aided financially by A. B. Abrams, of Baxter Springs, a homeless New York Indian with a Jewish ancestry. Abrams has succeeded in gathering unto himself and relatives 1700 acres of valuable land in north-eastern Oklahoma and is now secretary of the Quapaw tribe. One of the rewards of ex-Governor Crawford's efforts at Washington was his acquisition of 160 acres at Lincolnville, Oklahoma, on which the famous Omaha-Petersburg mine was located.

The allotment of Quapaw lands was made in 1896, each adult allottee receiving 240 acres. Although most of the land was highly productive the members of the Quapaw tribe, not more than 500 in number, gave little attention to its cultivation. Many of these Indians are almost what might be termed 'blanket Indians' and their homes consist of rude huts in the backwoods. They lack every vestige of ability to promote the development of their rich mineral lands, and, instead of being able to go forth and organize mining companies on their own responsibility and share in the greater profits to which they are entitled, they are content with receiving a mere pittance, comparatively speaking, although in reality the royalties they are receiving aggregate a good many thousands of dollars each month. They are willing to

QUAPAW INDIANS OF NORTH-EASTERN OKLAHOMA. MANY IN THIS GROUP ARE OWNERS OF RICH ZINC AND LEAD TRACTS, THE ROYALTIES FROM WHICH MAKE THEM INDEPENDENTLY WEALTHY.



THE CORNFIELD MINE. A ZINC-LEAD PRODUCER IN OKLAHOMA. THE INDIAN LAND-OWNER OF THIS MINE PREFERRED CASH IN HAND TO FUTURE ROYALTIES.

lease their lands at 5% and would still be willing to take a cash settlement of a few hundred dollars rather than take their chances on getting thousands or hundreds of thousands of dollars in royalties later on; but Uncle Sam has awakened to the necessity of protecting them to some extent at least. Oftentimes the lessees who procure the lands at 5% royalty sub-lease the same properties out for 10, 15, or even as high as 40% royalty where the ore is rich, and while the actual land-owner is thus receiving a meager 5% return, the middle-man, or first lessee, who really does no actual mining himself but who encourages others to mine, sits back at his leisure and rakes in his big royalties, frequently getting independently wealthy in the course of a year or so.

In Ottawa county there are seven other Indian tribes, but so far the Quapaws have been the only ones fortunate enough to own mineral-producing lands. The Cornfield mine, shown in an accompanying illustration, is a new producer of importance on the land of Benjamin Quapaw, who assigned his royalties to a Kansas speculator. Harry Crawfish sold, for a song, his royalty rights on the lease north of Miami where the Picher Lead Co. has opened one of the most productive zinc-lead mines in that district. Julia Greenback owns the land on which the Lost Trail mine is situated. She, likewise, disposed of her royalty rights for a few hundred dollars, whereas, by waiting, she would have received something like $15,000 in royalties.

Leaching at Yerington

Some months ago the General Development Co. was induced to undertake extensive drill exploration at the Copper Flat property, two miles west of Yerington, Nevada. The work was in charge of Louis F. Wright, of the General Development Co.'s staff. About 700,000 tons of 2½% ore was developed on a part of the ground and enough work was done to justify a total estimate of 2,000,000 tons of ore, all oxidized. The Walker River Copper Co. has been incorporated in Nevada to undertake the work of exploration.

The laboratory work in developing a process to treat the ore was done in the plant of the Midland Ores & Patents Co., at Waverly, New Jersey, and the results have been satisfactory enough to justify the drafting of plans for a 400-ton mill. The proposed process is comparatively simple and economical. The ore will be treated with an acidulated solution of ferric chloride containing sodium chloride. The copper will be precipitated on granulated iron in tumbling-barrels in the usual way, the resulting ferrous chloride will be regenerated to ferric salt by the electrolytic deposition of sufficient metallic iron to liberate the requisite amount of chlorine. The economy of the process lies in part in the regeneration by electricity of the spent solution and the recovery of the excess iron, permitting the repeated use of both without material loss. At the one-ton plant of the Midland company, it has been found possible to use the solution as many as 14 times and it was still in good condition for further use. Test-runs have been made on many different oxidized silicious copper ores and from those at all adapted to the method, a recovery of 90% has been usual.

A solution containing 3% ferric chloride and 5% salt has proved an effective solvent with most ores. The amount of iron entering the solution in the copper precipitating step is theoretically 50% in excess of the amount separating in the ore treatment when the copper dissolves. The acid required is the amount necessary to re-dissolve such iron as may separate by reason of oxidation or basic reactions.

In the regeneration an efficiency of 95% has been obtained at the anodes and 75% at the cathodes. The current strength is 3 to 4 volts and current density 4 to 6 amperes per square foot. The deposited iron is used to precipitate the copper, with a corresponding reduction in the amount of scrap-iron.

The reactions incident to the several steps are as follows:

Ore treatment

$$3CuO + 2FeCl_3 = 3CuCl_2 + Fe_2O_3$$
$$3CuO + 2FeCl_2 = CuCl_2 + Cu_2Cl_2 + Fe_2O_3$$
$$CuS + 2FeCl_3 = CuCl_2 + 2FeCl_2 + S$$

NOTE. If the solution is acid the iron remains dissolved in proportion to the amount of acid used.

Copper precipitation

$$CuCl_2 + Fe = Cu + FeCl_2$$
$$Cu_2Cl_2 + Fe = 2Cu + FeCl_2$$
$$2FeCl_3 + Fe = 3FeCl_2$$

Regeneration

$$FeCl_2 + \text{electrolysis} = Fe + Cl_2$$
$$2FeCl_2 + 2Cl = 2FeCl_3$$

Blast-Furnace Gases in Silver-Lead Smelting

Oxygen is present from 0 to 1.5%, and in a well-running furnace not in excess of ½%. With the higher content, namely, toward 1½%, reduction is poor.

In current practice where much sintered ore is used, a good deal of galena remains undecomposed in the sinter. If this is not decomposed in the blast-furnace, some enters the slag as lead sulphate, so that the fume arising from such slag, when it is spilled on the dump, may contain as much as 52% lead.

When the matte goes as low as 12% lead, reduction is good; when it runs up to 22%, the reduction is poor. In the first case the slag may carry no more than 0.5%, in the latter case, as much as 2 to 2½% lead.

All these statements refer to normal tonnage conditions and not when the furnace has been pushed by a plentiful supply of air, exceeding its capacity.

SIXTEEN PLANTS in the United States in 1914 produced 250,635 tons of coal briquettes worth $1,154,678. This was an increase of 37.82 per cent.

Mining in Arizona

By CHARLES F. WILLIS*

The past month has made a record in the annals of Arizona mining. New discoveries galore, record productions at a decreased cost, new plans announced, consolidations, bonding and leasing, and, perhaps, what is best of all, the number of engineers coming to the state to make examinations. Copper is, of course, the most active but this has been closely followed by favorable developments in the new goldfield of Oatman or Gold Road. The demand for properties containing tungsten and molybdenum has been marked and many options on properties of this nature have changed hands, accompanied by increased activity at the mines of tungsten and molybdenum already in operation.

One of the largest transactions consummated in recent years, and from a copper mining standpoint of far reaching effect, is the taking over of the interests of the Gila Sulphide Copper Co. by the American Smelting & Refining Co. This is the well-known Christmas mine, near Hayden, one of the most promising of the low-grade properties in the state. With the necessary improvements to handle a large tonnage, success is assured. It is also reported that the A. S. & R. has purchased the Bush & Baxter mine in the Twin Buttes district. This is a property that will make interesting reading for the get-rich-quick promoter's prospectus. With a total outlay of only $350, to do the assessment work, a few months ago in a neglected district, over $1000 per day is being cleared. The reported sale price is $400,000.

Jerome has turned its attention during the past month to consolidations, the result of which has been that practically the entire district is now in the hands of two companies. Extensive geological work has been recently done in this locality by Walter Harvey Weed, in the employ of the United Verde Copper Co. the result being that the United Verde has taken under its wing all of the properties of the Hull and Cleopatra mining companies, the consideration being stated as about $1,000,000. The United Verde Extension Mining Co., of which James S. Douglas is president, has gathered pretty nearly all of the surrounding claims not included in the United Verde transaction. Deals have been closed on the Hooker and Ewing interests, the Mountain View, the Bouquet, the Parker, the Lippey, the Stifel, and the Johnson groups. By these acquisitions the United Verde Extension owns 30 mines, all of which adjoin the present holdings on the south. The sale of the Harris mine in the Black Canyon district to an Oklahoma corporation is another notable event.

The Globe-Miami district is prominent. Three sections of the Inspiration concentrator, to treat 2250 tons per day, have been started. Two more units will be started during July and probably three more monthly until the entire 18 units are working. This marks the beginning of active production by the Inspiration Consolidated Copper Co. When completed the concentrator will have a capacity of from 14,400 to 15,000 tons daily. Early in the month, the International smelter was blown-in, in the same district; this has been handling the Miami company's concentrate, which has been stored for several months. The International plant will also handle the product of the Inspiration mill. The Old Dominion, although almost drowned in the month of April, has overcome all its difficulties and is back to full capacity. The blowing-in of the third furnace recently has marked its rise to maximum production again.

Two new railroads have been put into operation within the month. A narrow-gauge road, 28 miles long, connects the Magma mine at Superior with the railroad at Florence. This road overcomes the handicap that the Superior district has suffered for many years, and it is now anticipated that there will be increased mining activity there. The town of Mascot was connected with the outside world on June 15. The event was suitably celebrated. The railroad connects the property of the Mascot Copper Co. at the new town of Mascot, in the Dos Cabezos mountains, with the Southern Pacific line at Willcox.

In the southern part of the state much activity is evident. Contracts have been let for the construction of the Gila Bend-Ajo railroad, connecting Gila Bend on the Southern Pacific line with the property of the New Cornelia Mining Co. at Ajo. The contract calls for the completion of the road by January. It is evident that the company is going to lose no time in getting its copper on the market. The road will be about 40 miles long and will have a maximum grade of 0.5%. It is hoped to complete the erection of the reduction plant next year. In the Ajo district, extensive diamond-drill prospecting is being conducted by the E. J. Longyear Co. for the Ajo Consolidated Copper Co. Day and night shifts are being used, and the work is progressing rapidly.

It has been definitely announced that the Sacramento central hoisting-shaft of the Copper Queen Consolidated Mining Co. at Bisbee, will be concreted from the 1700-ft. level to the surface, making it a fire-proof shaft. The work will commence as soon as the material arrives and it is anticipated that it can be done in 60 days. A preliminary test made in this shaft proved that the work could be executed in a satisfactory manner, according to plans already completed, both from the standpoint of expense and workmanship. A novel feature of this work is that it will be the first instance of a shaft being concreted while still in use. Officials of the company express complete confidence that the work will be carried out perfectly, and it will be watched with much interest

*Director Arizona State Bureau of Mines, Tucson, Arizona.

by mining men. This achievement is made possible by the type of form adopted. After the concrete is put in place, all that becomes necessary will be to connect the stringers in the shaft and proceed to the work of hoisting. The placing of the concrete will all be done from skips and cages, no platforms being put in the shaft; it will be started at three places in the shaft, at the 600, 1200 and 1700-ft levels. George Meyers, chief master mechanic, is in charge of the work.

During the past month the Bunker Hill Mining Co., new owners of the old Tombstone Consolidated, will again come into line as producers. The test-mill has been re-constructed and sufficient ore is blocked out to run this mill at the rate of 100 tons daily. During this time the best method of treatment will be determined. It is evident that Tombstone is to be revived. The Bunker Hill Mining Co. is a Phelps-Dodge enterprise, a connection that generally spells success.

All of the large copper mines of Arizona have been pushing their production while copper has been rising but the Calumet & Arizona is passing all records and is now producing almost 6,000,000 lb. per month, although there has been no increase in the number of men employed. The Calumet & Arizona is today a big earner with fine mines producing ores of the direct-smelting class, and its new smelter, the best to be found anywhere. Conditions at the C. & A. allow such flexibility of work as is necessary to meet varying economic conditions, thus permitting high production at a low cost.

Notable among the new discoveries of the past month is that of vanadium in commercial quantities in the Shattuck mine of the Warren district. This mine, which has been familiarly known as "the biggest little mine," has a record for the variety of commercial mineral deposits found within its workings. Vanadium makes a notable addition.

The intense excitement that followed the finding of rich gold ore on Juniper Flats, north of Bisbee, has settled down to the steady development of a few claims. The Truax brothers, who were among the first discoverers of the district, are steadily developing their claims. While it now looks as though it may prove a gold district of some merit, it is not likely to be a bonanza.

Near Kingman, at the Enterprise Mines, rich telluride ore has been reported. Samples assayed at Kingman ran from $4000 to $6000 in gold and high in silver. This property has been recognized for some time as a producer of lead, copper, and zinc. It is evident that the silver and gold values were overlooked.

The development of the Commonwealth Extension at Pearce has recently disclosed 5 to 7 ft. of ore averaging $20 per ton. Machine-drills are shortly to be installed on this property, which aspires to be another Commonwealth, and has a good start in that direction.

Never at any time has the mining situation in the state of Arizona been as promising as at the present time. With the high prices of all the metals, the mines are all working at 100% capacity, and in many cases at an overload. Wages are the highest during the present decade.

Russian Copper Production

The production of copper in the year 1914, according to the report of the Russian syndicate known as the Mied, was not as large as had been anticipated, according to the estimates of the factories included in the syndicate and within its radius of influence. Instead of the expected increase in the production compared with the preceding year by over 400,000 poods (6451 tons), as a matter of fact the quantity of copper smelted did not even reach the level of 1913. It amounted to 1,968,660 poods (31,752 tons) only. Such a reduction, according to the report of the syndicate, must be ascribed in the first place to the influence of the War, which brought about a complete shut-down in the month of October at the Dzansul plant of the Caucasian Copper Co., the failure to start the Kvarty Chan smelter of the Siemens Successors, and the reduced number of workmen at all the remaining plants. Besides these causes of reduced production, the influence of which was seen in the second half of the year, there were others of a sporadic character that acted unfavorably on the production of copper. In the course of the first half of the year, under conditions of peace, all the copper-smelting works, except Kyshtim and Verch-Isset, instead of increasing their production, fell short of that of the preceding year by about 40,000p. (645 tons), and only at the two smelters named was there an increased output: at the former of 34,463 poods (555 tons) and at the latter of 17,605p. (283 tons). Compared with the preceding years the production of 1914 shows as follows:

Total Production of Copper in the Russian Empire

Year.	Poods.	Tons.
1910	1,378,399	22,232
1911	1,564,010	25,225
1912	2,062,731	33,269
1913	2,048,393	33,038
1914	1,968,660	31,752

The production of copper according to districts was as follows:

	1913.		1914.	
District.	Poods.	Tons.	Poods.	Tons.
Uralsk	997,279	16,085	1,026,723	16,560
Caucasus	619,398	9,990	517,452	8,346
Siberia	346,684	5,591	338,088	5,453
Chemical works and refineries	85,032	1,371	86,397	1,393
Total	2,048,393	33,037	1,968,660	31,752

The consumption of copper in Russia for 1914 amounted to 2,072,318p. (33,424 tons), or 10,614p. (171 tons) more than in 1913 and 192,659p. (3107 tons) more than in 1912. According to estimates, the production of copper in 1915 is expected to be 2,165,000p. (34,919 tons), or 196,340p. (3166 tons) more than in 1914.

In view of the exceptional circumstances* under which the Caucasian Copper Co.'s works are placed, no copper is expected to be produced there this year. Last year this company produced 192,538p. (3105 tons).

*The mines and smelters are in a region now the scene of military operations between Russia and Turkey.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Flow of liquids is faster from a square orifice than from a round one.

Scrap metal worth over $50,000,000 is recovered in the United States each year.

Ancient river-channels in Sierra county, California, have averaged $150 to $500 in gold yield per linear foot.

Efficiency of belting depends primarily on its strength, speed, and the arc of contact with its pulleys.

Design or lay-out of underground tramming systems, especially switches and crossings, is of considerable importance in a mine of large output.

Ball-bearings are considered a success in electric motors. Mining locomotives, which get fairly rough usage, are fitted with them, resulting in decreased repair bills.

The advantages of using dynamite that will not freeze until after water freezes, is recognized by practically all large users of explosives whose operations are carried on in freezing temperatures.

Blast-furnace slag was considered a nuisance in reducing iron ores. Now it is a valuable residue, as it is used in road construction, ballasting, railways, concrete, fire-proof floors, roofing gravel, and in the manufacture of cement.

Leather belts are affected by changes in the weather. A damp atmosphere lengthens these belts, decreasing their tension on pulleys. Balata belts get very slack in dry weather, and tight when wet. Rubber belts are hardly affected.

Extractions of metal based on differences of assay-results in experimental work should be definitely stated as assay-extractions, and should be clearly distinguished from possible or probable recoveries. The actual extraction sometimes exceeds the assay-result, but when it exceeds 100% it shows that the sampling is not accurate.

Leaky pipe-lines may be repaired cheaply by oxy-acetylene welding. At Ophir, San Miguel county, Colorado, pipes at the Carribeau mine required over 100 patches. In two days these were repaired at a cost of one-third of what new pipe would cost, not counting a shut-down to put in new pipe.

Pennsylvania oil is practically free from sulphur and asphalt, is rich in paraffin wax, and yields a high percentage of gasoline and illuminating oil. For many years it has been first in demand by the refiners, and though modern refining methods have succeeded in remedying to a notable degree the deficiencies of crude petroleum from other parts of the United States, Pennsylvania grade still retains its rightful prestige and forms the criterion by which the merits of other crudes are judged.

The Government employs geological and mineral experts to make examinations of mining claims within the National Forests; but, unless the claims are actively interfering with the administration of the Forests, no examinations are undertaken until application for patent is made. The proportion of mining claims examined prior to application for patent is very small, probably less than 1% of the total number located. There are thousands of mineral locations within the National Forests of which no examination has been made by the Forest Service, and in all probability never will be except in cases where application for patent is made.

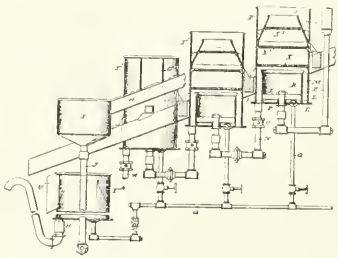
Terne plate is made by passing thoroughly cleaned steel plates through molten terne mixture. This terne mixture is an alloy of pure tin and pure lead in varying proportions, the most common mixture being 27% tin and 73% lead. When plates emerge from the bath of molten metal they are thoroughly covered with a fairly uniform coating of this alloy. Since terne mixture itself is practically incorrodible, long service may be expected from a roof formed of this material. Terne plates are furnished commonly in sheets 20 in. by 28 in., 112 sheets to the box, but as in the case with galvanized and black sheets it is also furnished in the form of roll roofing where the sheets are soldered on the ends and ready to roll out on the roof and fasten at the sides in one of the well-known methods of flat-seam or standing-seam construction.

Nickel may be qualitatively detected in ores by powdering a small sample and dissolving it in aqua regia. The solution should contain 10 to 15 c.c. of double normal acid to every 100 c.c. of solution. H_2S is then passed into it until it is saturated, dilute with an equal volume of water and pass in H_2S until it is again saturated. Filter off the precipitate, the nickel is in the filtrate. Boil out the H_2S, add ammonia to alkaline reaction, and then add colorless $(NH_4)_2S$ until no further precipitate is produced. The nickel is in the precipitate. This should be washed four times with water containing $(NH_4)_2S$, three times with pure water and then treated, with constant stirring, with cold double-normal hydrochloric acid until no more H_2S is given off. Any precipitate that remains undissolved may be the sulphide of nickel, cobalt, or both. Wash it well, and dissolve in aqua regia, evaporate the solution to dryness. Dissolve in a little water and add KCN solution drop by drop until the precipitate first formed re-dissolves completely; 2 or 3 c.c. of caustic soda solution is then added and chlorine conducted into the cold solution. If nickel is present a black precipitate of $Ni(OH)_3$ is formed within a few minutes.

Recent Patents

1,141,377.—Ore-Concentrating Apparatus. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co. Filed October 6, 1913. Serial No. 793,695.

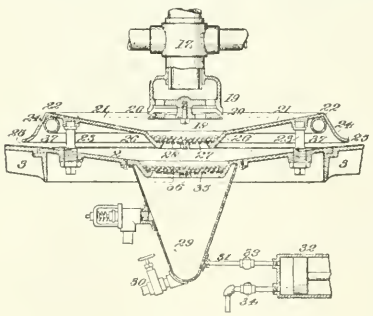
1. In apparatus of the character described, the combination of a tank or receptacle adapted to receive ore pulp and a substance having the property of frothing in the presence of a gaseous medium and agitation, a casing within the lower portion of the tank and separated therefrom to form a surrounding space or chamber, a body of porous material within said inner casing and supported above the bottom thereof so as to



form a chamber between said porous body and the bottom of the tank, a feed pipe terminating in the lower portion of the tank above the porous body and adapted to deliver the pulp into the casing above said body, a pipe leading into the chamber below said porous body and adapted to admit a gaseous medium under pressure thereinto, said porous body subdividing the gaseous medium and distributing the same irregularly substantially throughout the entire surface of the pulp, and a discharge means connecting with the space or chamber between the inner casing and the tank and adapted to deliver therefrom the heavier material which has settled into said space.

1,141,419.—Combined Batea, Jig, and Pan Motion Concentrator. Karl Senn, Alameda, California. Filed June 18, 1914. Serial No. 845,841.

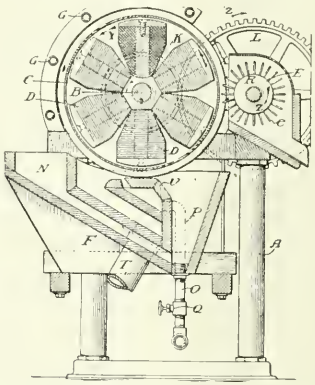
1. The combination in a concentrator, of a concave pan with a central discharge, means for feeding pulp at the centre of the pan, a screen in the pan discharge and supporting a mobile



mass, the particles of which are too large to pass through the screen, means for gyrating the pan to agitate said mass and the ore solids concentrated, the concentrate gravitating toward and through the screen and the gangue being washed outwardly by the wave action and water flow, means for hydraulically jigging the concentrate and the mobile mass at the screen, and a preliminary separator superposed above the pan discharge and into which the feeding means discharges pulp, the rim of the separator being adjustable relative to the surface of the pan to form an annular mouth, through which a counter-current, derived from the jigging means, runs outward.

1,141,833.—Magnetic Ore-Separator. Sven Ragnar Salwén, Grangesberg, Sweden, assignor to American Grondal Co., New York. Filed October 9, 1914. Serial No. 865,924.

1. In a magnetic separator, a plurality of magnets of alternating polarity mounted on a suitable axis, a rotary magnetic drum arranged around said magnets and in close proximity to

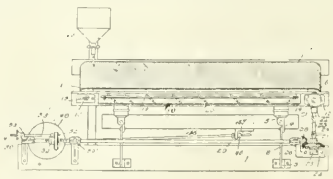


their poles, and means for rotating the magnets and drum simultaneously in opposite directions.

2. In a magnetic separator, a plurality of magnets of alternating polarity mounted on a suitable axis, a rotary magnetic drum arranged around said magnets and in close proximity to their poles, and means for rotating the magnets and drum simultaneously in opposite directions in combination with means for washing the ore while it is tumbling over the face of the drum.

1,141,852.—Process of and Apparatus for Sizing of Classifying Comminuted Materials. Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Texas. Filed July 21, 1913. Serial No. 780,360.

1. The process of sizing a mass of comminuted material, consisting in subjecting a mass of material containing particles of



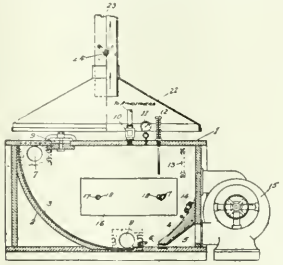
different sizes in dry condition, to a continuous movement in one direction upon a moving support, causing the particles to gravitationally deviate from the line of normal movement, retarding said gravitational deviation and so proportioning the forces, that the deviation shall be proportional to the size of the respective particles, and separately collecting the thus sized particles.

2. The process of sizing a mass of comminuted material, con-

sisting in subjecting a mass of material containing particles of different sizes in dry condition, to a continuous movement in one direction upon a continuously moving support, causing the particles to gravitationally deviate from the line of normal movement of the material, retarding said gravitational deviation to cause the particles to travel contiguously and so proportioning the forces, that the deviation shall be proportional to the size of the respective particles, and separately collecting the thus sized particles.

1,142,462.—Ore-Disintegrator. Leon St. D. Roylance, San Francisco, California. Filed December 27, 1912. Serial No. 738,830.

1. In an ore-disintegrator, a tank for holding the solution containing the ore, an abrading surface within said tank, elec-

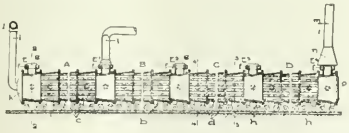


trodes positioned within said tank and means for causing the contents of said tank to circulate to impinge upon said abrading surface and pass between said electrodes.

2. In an ore-disintegrator, a tank for holding the solution containing the ore, an abrading surface within said tank, electrodes positioned within said tank, a compartment provided with an elongated opening to said tank positioned opposite said abrading surface, and means for drawing solution from the tank and returning the same to the tank by discharging into said compartment.

1,142,324.—Treatment of Subdivided Ores for Agglomerating or Reducing them and Apparatus Therefor. Gustaf Gröndal, Djursholm, and Herman Nilsson, Nyhammar, Sweden. Filed May 23, 1914. Serial No. 840,549.

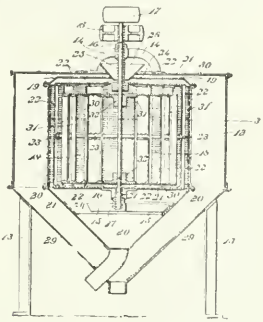
1. A method of treating subdivided or pulverulent ore consisting in packing the ore, in a moistened state into an iron receptacle open at both ends, providing longitudinal channels in the ore, arranging a number of such filled receptacles in



series adding thereto a suitable fire-place, passing the combustion products through the said channels until the ore in the receptacle lying next to the fire-place is brought to the desired state, afterward removing this receptacle containing the ore and placing it on the other side of the fire-place to be traversed by the air for combustion moving the series of remaining receptacles toward the fire-place and placing another receptacle filled with fresh ore at the other end of the series, and so on, substantially as described.

1,141,988.—Screen or Separator. Thomas Joseph Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co. Filed March 1, 1913. Serial No. 751,560.

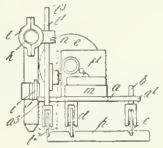
1. In a separator, the combination with a suitable casing, of a vertically disposed stationary screen within the said casing, a vertically disposed rotating fan arranged adjacent to said screen and provided with alternating reversely inclined blades all disposed in one circular plane and serving to produce alternating reversing or pulsating air currents, and means for



supplying to the upper part of the separating means the material to be screened.

1,141,560.—Apparatus for Severing Metals by Fusion. Charles Tibbit Lack, Impington, England, assignor of one-half to Chivers & Sons, Limited, Histon, England. Filed November 25, 1914. Serial No. 874,053.

1. In apparatus for severing metals by fusion, the combination with a blow-pipe, of a carriage, adjustable wheels on said

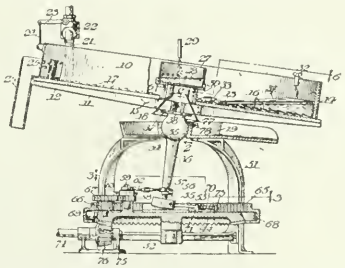


carriage for adjusting the angle of cut and a motor geared to one of the wheels of the carriage to propel the same during the severing operation.

2. In apparatus for severing metals by fusion, the combination with a blow-pipe, of a carriage, adjustable wheels on said carriage for adjusting the angle of cut, a motor geared to one of the wheels of the carriage to propel the same during the severing operation, and an adjustable support carried by the blow pipe for controlling the path of movement of the carriage.

1,141,972.—Pan-Motion Concentrator. Charles H. Muhleman, Western Springs, Ill., assignor of fifty-five one-hundredths to Frank Low, St. Louis, Mo. Filed June 4, 1914. Serial No. 842,862.

1. In a concentrator, in combination, a pan and a supporting column therefor, means for tilting the column, means for tilt-



ing the pan independently of the column and means for revolving the column about a vertical axis without rotation of the column.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

PLATTEVILLE, WISCONSIN

Worries of Zinc-Ore Producers.—New Separating-Plants.—Ore Prices.—Calamine.—District Outputs and Buyers.

In many ways June was an interesting month in the zinc-ore mining districts.

Probably in no other region in this country is there so wide a disparity in metal content as found here. Production includes material by wet concentration containing from 20% to 60% zinc. As long as smelter representatives offered a market for the medium and lower grades, operators were content to make delivery with a small profit. These same low-grade producers thought that the rapidly advancing offers for both metal and ore would enable them for once at least to get a fair return on their labor and investment. Instead, as the demand for metal became radically abnormal, so also became the demand for high-grade ore only, which could be converted into metal quickly. Low-grade producers found themselves utterly ignored. Production was splendidly maintained regardless of the absence of demand, until at the close of the month there was 10,000 tons of surplus ore at all points containing under 50% zinc. Machines were needed to make better products. The Mathey revolving cylinder and the Cleveland-Knowles and Dings' separators have been in use in this field for many years. The introduction of electrostatic separation found two types of machine adaptable for this method of reduction to high-grade product only, the Blake-Morscher and the Huff (Boston) type. The latter has gained more in favor until today it is greatly used, yielding as high as a 62% zinc product.

The abrupt demand for finished product found the few separating-plants in the field utterly unable to meet the demands made on them, and mining concerns decided quickly, with the following results: A new 1000-ton separating-plant of the Skinner type is being constructed in the New Diggings district; a new custom-plant is being built in the Mifflin district to accommodate the Peacock Mining Co. and others in the immediate vicinity; in the Platteville district the independent separating-plant of the Homestead Mining Co. has been converted to public patronage, and all low-grade producers are turning their output into the plant for reduction; in the Shullsburg district the Fields Mining & Milling Co. is rushing to completion a new separating-plant to handle the ore from two producers capable of supplying 800 tons of raw ore per week; the National Separating Works has increased the capacity of its plant at Cuba; and the same was done at the Linden and Mineral Point establishments. While production of raw ore is to be considerably increased by the starting of a score of new producers on thoroughly proved properties, deliveries will scarcely show much increase in tonnage. The gain will all be in the value made. In addition, a stronger element of competition will be injected into the field on high-grade open-market offerings exclusively, as is already witnessed in the introduction during the month of new buying interests, notably the Robert Lanyon Zinc Co., Picher Lead Co., Granby Mining & Smelting Co., and the Edgar Zinc Co.

Zinc ore at the beginning of the month was bid in on a basis of $68 per ton for 60% metal content. Operators alleged that smelters were giving them a bad deal. Whether this was true or not, there may have been something in it as the Picher Lead Co.'s buyer immediately raised the price of 60% ore to $90 per ton. After several weeks $130 per ton had been reached. The best information during the month came from the Fields Mining & Milling Co., which, under contract based on the ruling quotations on spelter enabled it to secure $156.11 per ton for 42% product. Four cars of ore realized over $20,000. Fortunately for the smelters, many of whom contracted metal long periods in advance at 7 and 8c. per pound, not many contract arrangements for ore deliveries existed, and contracts expiring have not been renewed. Smelters have been hard hit on the lower-priced metal deliveries, by being compelled to pay high prices for ore. The close of the month found both ore and metal receding, but still remaining abnormally high. Zinc-ore bids ranged at the close of business June 30 from $90 to $115 per ton 60% basis. Buyers also showed less inclination to submit offerings, some even admitting instructions demanded restriction in buying.

Lead ore started the month at $52 per ton for 80% metal content. Here also sensational developments featured business, prices advancing rapidly to $60 per ton. New buyers again were responsible for improved offerings, and bidding revealed inside deals at $70 per ton. This figure was not long maintained, and the end of the month saw lead ore established firmly on a base of $60 per ton. Considerable ore of this class held close, came to the surface, and deliveries were slightly improved, but producers showed little disposition to unload. The reserve in the field at the end of June was over 2500 tons.

Pyrite business was fairly good, when on June 15 the burning of the Wilkinson mine equipment, removed the chief producer. The plant will be re-built without delay, production will be maintained. Separating-plants securing pyrite as by-product, unloaded freely during the month at an average of $3.75 per ton f.o.b.

Carbonate zinc ore producers held for years under the control of the New Jersey Zinc Co., witnessed the most remarkable advances of any branch of the industry, the calamine base of the Missouri field applying to this commodity. At no time has ore of this class changed hands at over $20 per ton, but near the end of the month offerings were strong at $80 per ton, 40% zinc. The Wisconsin ore is converted into zinc oxide, which is mostly used in the manufacture of paint. The Picher Lead Co. again violated all injunctions of the 'fraternity' by breaking into the northern districts for carbonate ore to be used in the manufacture of spelter. The ore was delivered to the smelter at Collinsville, Illinois; under lease to the Picher Lead Co. Thousands of tons of mill-feed are being piled on the dumps, and the season's clean-up was well on all the month.

Shipments in June were as follows:

Districts	Zinc Pounds	Lead Pounds	Pyrite Pounds
Benton	9,898,000	64,900	1,465,300
Galena	4,976,000	162,000	.....
Hazel Green	4,178,000	60,000	.....
Cuba City	3,054,000	.....	1,469,440
Platteville	2,792,000	.....	.....
Livingston	2,534,000	.....	.....
Linden	1,230,000	.....	.....
Dodgeville	632,000	.....	.....
Shullsburg	616,000	.....	.....
Highland	576,000	.....	.....
Mifflin	364,000	.....	.....
Mineral Point	104,000	.....	.....
Total	30,954,000	286,900	2,934,740

The sales were divided among the following buyers: Mineral Point Zinc Co., 5843 tons; National Zinc Works, 2212; American Zinc Co., 1875; Matthieson & Hegeler Zinc Co., 1071; Empire Roasters, 964; Illinois Zinc Co., 778; Grasselli Chemical Co., 682; Campbell Roasters at Cuba, 530; Linden Zinc Co., 448; Picher Lead Co., 376; American Metals Co., 282; Granby Smelting Co., 98; Edgar Zinc Co., 40; Lanyon Zinc Co., 339 tons.

Newly-developed mines were brought to the producing stage; others were closed on account of the market; and to prevent a strike among miners as in Missouri wages were raised 25c. per day.

During the week of June 20, Attorney-General Barker, of Missouri, filed information in the state Supreme Court against 28 companies alleged to be interested in the purchase of zinc ore in the Missouri districts stating that he had reason to believe they were in an unlawful combination to control prices. All of the companies represented in the Wisconsin field were cited. The court is asked to appoint a commissioner to take testimony, with the ultimate view of filing proceedings against any or all of the companies the testimony may show guilty of the practices charged.

CRIPPLE CREEK, COLORADO

Gold Output in June.—Golden Cycle, Portland, Blue Bird.

The estimated production from the Cripple Creek district during June, as reported by the mills and smelters, is as follows:

Plant	Tons	Average value	Total
Smelters	4,700	$55.00	$258,500
Golden Cycle Mill	36,000	20.00	720,000
Portland, Colorado Springs	12,000	19.50	234,000
Portland, Cripple Creek	18,250	3.14	57,305
Stratton's Independence	8,000	3.20	25,600
Gaylord	1,800	2.50	4,500
Wild Horse	690	3.50	2,380
Total	81,440	$16.00	$1,302,285

During the month five of the local mills were shut down most of the time for various reasons. The Kavanaugh, Neville, Ajax, Isabella, and Jerry Johnson mills did practically nothing during the entire month.

It is expected that the Golden Cycle Mining Co. will pay its regular monthly dividend of 2c. per share on July 10. The distribution will be $30,000.

At a recent meeting of the directors of the Portland company it was decided to increase the regular dividend for the current quarter of the year from 2 to 3c. per share. This dividend will be paid on July 20 to stockholders of record on July 12, and will amount to about $90,000. This will bring the total dividends paid by the Portland company to a little more than $10,000,000.

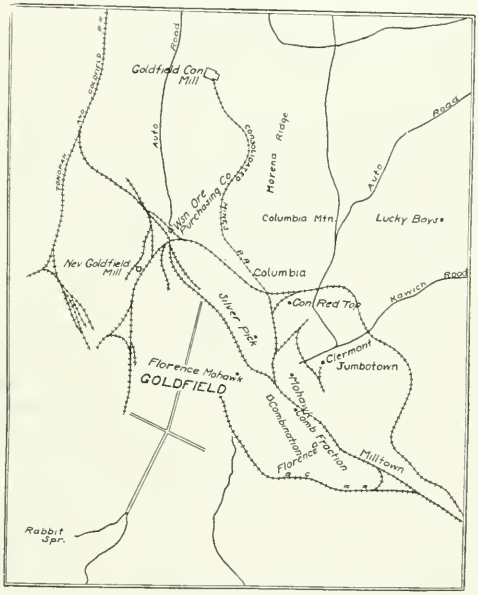
[At the Palace of Mines and Metallurgy at the Exposition at San Francisco, a model of the Portland company's sampling-plant is shown. It is driven by a ¼-hp. Westinghouse motor. The Short Line train brings ore to a large bin. The ore-flow is then as follows: jaw-crusher, elevator, rolls, trommel, coarse from trommel returned to rolls by No. 1 elevator, high elevator feeding Vezin sampler, first cut through rolls, three cuts in all, excess ore then taken by belt-conveyor to railroad cars.—Editor.]

The past week has been a broken one, and generally quiet. All of the mines and mills shut down for two days over the Fourth and fifth. Numerous reports may be heard about important developments being made, however, if one bears in mind that "many are called but few are chosen" he will not believe all reports about wonderful discoveries. Nothing new has developed concerning the new Blue Bird mill. It is generally thought, however, that as soon as the preliminary plans are completed, the option on the estate will be taken up and construction on the mill started. The dry clear weather which the district has enjoyed for the past few weeks has greatly favored the working over of old dumps. Considerable revenue is being earned from this source.

GOLDFIELD, NEVADA

District Tonnage.—Jumbo Extension Yield, Developments, and Management.—Merger and Atlanta Companies.

Companies and lessees of this district are sending over 300 tons of smelting ore daily to the sampler of the Western Ore Purchasing Co. This comes principally from the Jumbo Extension, Atlanta, and Florence Mines, and from leases on the Red Top and Jumbo claims of the Goldfield Consolidated Mines Co. The Consolidated mill is treating 1070 tons per day. The equipment installed for the treatment of tailing, to supplement the production from the mines, has not been started yet, as there has been no lack of ore. Complete tests



GOLDFIELD DISTRICT, NEVADA.

are to be made with oil-flotation and other processes to devise a method by which the low-grade, refractory ores of the district can be treated profitably. It is reported that these tests will be made at the Consolidated mill.

J. K. Turner, in charge of the Jumbo Extension mine, estimates that company's June production at 2358 tons shipped to smelter, with a gross value, as indicated by control assays, of $93,000; freight, sampling and treatment costs $24,000; operating expenses $15,000; and net realization $54,000. This product was shipped to the sampler in 50 steel ore-cars. From January to June production was nominal and insufficient to pay costs, as the company was working under an injunction, issued by the Federal court at Seattle upon application by the minority faction of the Merger Mines Co. directors, and all receipts from ore marketed during that period were impounded in the bank. The company has since been freed of all litigation. Production will continue for the present at about the same rate as in June, owing to the limited capacity of the main Polverde shaft; but with the completion of the Velvet

shaft to the 1017-ft. level the output can be easily more than doubled. The best ore is exposed in the wide fissure that extends within the shale, but a larger tonnage, of almost equally good grade, is now exposed at the shale-latite contact, the latter channel lying above the former, both dipping south at about 30°. A drift lately started from the most southerly raise, No. 526-A, at a height of over 60 ft. above the 1017-ft. level, has exposed 6 ft. of $65 ore, while another raise and drift, at almost the same height show the same character of ore on the contact fully 300 ft. to the west. This is within approximately 250 ft. of the south end-line of the Jumbo Extension property, and less than 500 ft. from where the Merger Mines Co. is seeking the continuation of this orebody on the shale-contact, at a depth of 1175 ft. Six new faces in the Jumbo Extension mine, all in the newer workings at the south and all on the shale-contact, are showing high-grade ore, varying from $50 to $250 per ton. Nearly all recent production has resulted from development work, but stoping will be carried on east of the raises from the 1017-ft. level, in order to make room for filling with waste. Work is now being directed to the western part of the mine, where little development has been done, as the limits of the orebody have not been defined in this direction. Cross-cuts that were driven far to the southwest, in the shale, on the 921 and 1017-ft. levels, and which were long regarded as useless work, will now serve to facilitate the work in this part of the mine. The annual stockholders' meeting of the Jumbo Extension company will be held at Phoenix, Arizona, on July 19. The new board of directors will probably be composed of Charles S. Sprague, J. K. Turner, Ben Gill, A. I. D'Arcy, and Willard P. Ward of Colorado Springs. Mr. Sprague will be chosen president, Mr. Turner general manager, and Mr. Gill secretary and treasurer. Mr. D'Arcy will represent the Booth company's stock interest, recently acquired in settlement of that company's apex claims. Mr. Sprague already has more than enough proxies to control the meeting and all the principal stockholders will give him their support.

In Merger Mines territory, work is confined to the east drift along the shale-contact, at a depth of 1175 ft., and short raises from this drift, at intervals of 40 ft., to prospect the latite hanging wall, as in the Jumbo Extension mine the best ore of the contact area is found on this side of the silicious mass that lies between the latite and shale. The Jumbo Extension orebody appears to extend directly toward the Merger, but the latter may be compelled to drive from 100 to 200 ft. farther before finding this ore. The great fissure, in which high-grade ore is found in large quantity in the Jumbo Extension, also appears to dip into Merger ground and much interest will attach to the exploration of this fissure south of the Merger boundary and to the conditions that will be revealed at the point where this fissure reaches the basic granite, below the shale.

The future of the Atlanta mine must depend, in large measure, upon the discovery of a process by which the low-grade, base ore of this property can be treated. The main cross-cut on the 1750-ft. level was advanced through the vein for 107 ft., but not directly across the lode, which is approximately 80 ft. wide here. The manager, A. I. D'Arcy has reported that nearly all the material passed through by this cross-cut can be treated profitably with a suitable reduction plant on the ground. Smelting ore assaying $20 per ton is shipped at the rate of 50 tons daily. There is a considerable quantity of this ore available.

A west cross-cut at 500 ft. in the Silver Pick recently revealed the downward extension of the old Phelan lease vein. So far, it is 12 ft. wide. The assays, although low, are encouraging. A large flow of water was also encountered.

Several Goldfield men went by auto on July 12 to Silver Crown, the old Stimler centre, 50 miles west of Goldfield. They will inspect the mines and return next week.

LONDON

Spelter and Broken Hill.—Zinc Corporation.

The attitude assumed by the British government with regard to zinc is galling to the mines, and also to the makers of munitions in this country. The sanctity of international law is apparently of greater moment to the Government than the requirements of the Allied armies on the battlefields. Zinc concentrate shipped from Australia to Germany just before the outbreak of war is held as prize of war in English ports. English companies are not allowed to terminate their long-time contracts with German buyers, but must hold their production and re-commence delivery at the end of the war. In Australia efforts are being made to pass a law through the Federal parliament that will permit the mines to re-arrange their contracts. Any such easing of the situation would not help the Zinc Corporation or the Sulphide Corporation, which are both companies operating at Broken Hill, but registered under English laws. In some quarters the position does not create irritation, for it is held that no alternative method of disposing of zinc concentrate can be devised. The sale to American smelters is not considered as highly remunerative, even at the present level of prices, and the American smelters are reported not to be enthusiastic about the complex Australian product. As for starting zinc-smelting works in England, it is argued that two years would be occupied in building a plant, that suitable labor could not be procured, and that the money required for capital outlay is not forthcoming. Thus a general attitude of *non possumus* or 'it-can't-be-done' is prevalent. In the meantime the Broken Hill companies are doing their best with the production of lead, and the Associated Smelters Co. has been formed to operate the Proprietary's smelter at Port Pirie, under the joint ownership of the Proprietary, North, and South companies. Since its formation, the Zinc Corporation has taken a share to the extent of £100,000, and the money to purchase this share is to be raised by loans against profits.

The position of the Zinc Corporation deserves mention. On the outbreak of war, the finances were greatly inconvenienced by the moratorium, which prevented the directors calling in the funds that had been lent on short notice, so that the payment of the preference dividend had to be postponed, and also the payment of the purchase price of the Barrier South control. But this stringency has long passed away. The corporation, however, is feeling the inconvenience of not being able to collect a sum of over £45,000 from Aron Hirsch und Sohn, of Halberstadt, Germany, for zinc concentrate delivered, and an action has been entered in the Australian courts for the recovery of this amount. The necessity for such an action is intelligible only to those who are harassed by legal absurdities, national and international. It is presumably devised as a means for the eventual annulment of the Hirsch contract. In reading the report for the results during 1914 it is necessary to remember that the Corporation was formed 10 years ago to treat by flotation methods tailing-heaps containing large amounts of zinc, that had been accumulated by various mines at Broken Hill, and that in 1911, the position was strengthened by the absorption of the mine and plant of the South Blocks company, which was formed in the same year as the Zinc Corporation by the same group for the purpose of working the lead-zinc mine at the southern end of the Broken Hill district. The Barrier South company, of which control has recently been purchased, owns the mine to the south of the South Blocks, in earlier days called the South Extended. The work done by the Zinc Corporation now consists of mining and milling the South Blocks ore and treating the old zinc-tailing dumps. An abstract of the results in 1914 appears on page 91 of this issue. The revenue from concentrate, etc., was £448,992. Total charges were £330,042. Preference shares were paid 3s.6d. (84c.), and ordinary, 1s.6d. per share. Concentrate on hand is valued at £27,222. Investments are worth £226,947.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

In Alaska stibnite is one of the most widely distributed of ores, occurring as an accessory in many other ore deposits. Antimony bearing veins have been found on Seward peninsula, in the Nome river basin, on upper Fish river, and in the Kantishna district. Stibnite was frequently found in the concentrate from alluvial mining in the Fairbanks district and was later found in veins in many places in the district. A stibnite vein occurs at Port Wells, Prince William sound.

Fairbanks

All the creeks in the Fairbanks district are the scenes of unusual activity. Everybody is satisfied with the outlook. Up to the beginning of June the gold output was reported to be $300,000 greater than for the season up to that date of 1914. This results from earlier sluicing, four weeks in places.

At Tolovana a ditch is to be dug from Mike Hess creek to Livengood creek. This work will take most of the summer to complete. Ten sluice-heads of water will be available in the summer.

Juneau

The repaired shaft for the Central hoist at Treadwell was expected to be in place by July 10.

The Alaska-Juneau company will double-track 5500 ft. of its tunnel from the mill to the mine, according to P. R. Bradley. Grading for the mill is to be done this summer, but the plant will not be built until late in 1916. The Marcy ball-mill is to be experimented with. There are 300 men employed at present, in charge of J. Richards.

The Gastineau mill is treating 4000 tons of ore per day. Within a month this quantity will be increased to 6000 tons.

In the hills above the timber line the Alaska Gold-Belt company has machine-drills driving an adit, and by July 20 it expects to enter the ore-zone. This adit should cut ore at a depth of over 3000 ft. A lower adit has been started from the beach. A large tonnage of ore is calculated should be opened by this work.

Interesting contests were held at Treadwell on July 5. Three teams of six men each entered the first-aid display. The Mexican team won the prize of $150 with a rating of 97%; the Bullion followed with 93%; and the Treadwell with 92% winning $60 and $30 respectively.

In the fire-hose contest, stringing five lengths of hose from a hydrant 230 ft. distant, making connections and getting water, was won by the Bullion team in 19⅗ seconds. No other team succeeded in getting water under 28 seconds, the time limit first trial. In the second run the Cyanide team made it in 21 seconds, taking second money. The prizes were $250 for first and $100 for second.

ARIZONA

Mohave County

In the first half of 1915 the Oatman district's gold output was approximately $1,000,000 from 85,000 tons of ore, reduced by 60 stamps, and then cyanided. The Tom Reed and Gold Road mines were responsible for this yield. The June production was $165,000 from 14,000 tons. From January to July the Tom Reed returned $520,000 from 26,000 tons. Dividends in that period amounted to $272,886, or 30c. per share.

Seven claims, adjoining the United Western at Oatman, have been purchased by Globe and Miami men. A company is to be organized under the title of Clarissa Gold Mining Co. It will await further development in the United Western before starting.

ARKANSAS

Sevier County

Near Gillham, Arkansas, oxides and sulphide of antimony occur in quartz veins following the bedding planes of the shales and sandstones in which they occur. The orebodies occur in lenticular masses. They were first worked in 1873, and a desultory production was maintained from about ten mines for thirty years thereafter.

CALIFORNIA

Calaveras County

The old Thorpe mine's new shaft is down 67 ft. A 5-drill motor-driven compressor is being installed. A. H. Summerville is superintendent.

Inyo County

At the south end of Death Valley is a new district known as Silver Lake. Railroad is not far away. While water is scarce, it may be obtained from wells of moderate depth. There is little vegetation, and plenty of shifting sand. Temperatures rise to 130°F. in the shade. In the property of P. H. Lietzow and T. Koerner, high-grade gold ore has been opened, with some silver and copper. Country rocks are diorite and granite.

Kern County

A good deal of interest is being taken in the antimony deposits of this county. The San Emidio district contains several promising veins. The Kern County Land Co. owns land there. Erskine Creek deposits, 50 miles from Caliente, are attracting attention. Rich ore is said to have been found on Greenhorn mountain.

Nevada County

It is probable that the Kenosha mine near Grass Valley will be re-opened soon. The shaft is down 450 ft. on the incline. Financial troubles were the cause of the shut-down.——The Goodwin and Nicholls drift-gravel claims of the You Bet company have been leased to a syndicate of Chinamen, who will employ 75 men. San Francisco Chinamen are said to be largely interested.

Placer County

Development at the Herman mine near Westville has been very encouraging of late, notably on the Cavins vein. Trenching uncovered this orebody for 800 ft., where it was from 4 to 13 ft. wide. Four feet on the foot-wall assays from $2 to $12 per ton. The drainage adit is expected to cut the vein. A 30-stamp mill and other machinery is ready for work. S. H. Brockunier is in charge.

Plumas County

Several claims in the Soda Creek district are developing into profitable mines. At the Compton and McBeth Monitor mine a 6-ft. vein has been opened. A Straub 10-stamp mill is reported to recover $10 per ton. More stamps will be erected.

Shasta County

The old Greenhorn mine is shipping eight tons of very rich copper ore per day to Keswick. Some of it contains 60% metal. Haulage costs $6 per ton. High-grade streaks run through the main shoot, which is of peculiar formation.

Sierra County

The Downieville-Alleghany-Forest district is very active,

both prospecting and mining. Fifty men are employed at the Gold Bluff-Oxford mine in charge of G. Snyder. The 20-stamp mill is working. The Gold Point is being placed in condition for a larger output. Ten stamps are ready. Twenty stamps are crushing at the Monarch-Cleveland mines. D. McGonigal is manager. Shaft-sinking is progressing well at the Tightner. About 100 men are employed.

In three weeks' time the new 15-stamp mill at the Plumbago mine was erected. R. L. Hathaway was the contractor.——At the South Fork mine it is thought that the Tightner vein has been cut.

Siskiyou County

At the old Mt. Vernon mine on Cherry creek, J. S. Dobyns has opened a shoot for 300 ft., assaying from $5 to $18 per ton. A 500-ft. cross-cut adit is to driven. Five stamps are at work.——It is reported that T. George and sons, and R. Brown have sold their placer mine for about $20,000. It is situated on the east fork of the Salmon river.

Tuolumne County

(Special Correspondence)—At the Santa Ysabel mine, two miles south of Jamestown, the main shaft is being steadily unwatered. Work has been started at 400 ft. to develop the Mascot vein. Ore in this vein above 250 ft. will keep five stamps busy. Lessees in the Knox and Boyle mine are breaking a full face of ore in the south drift. The entire stope is in ore on the 700-ft. level, which is being broken with two machines working two shifts. Ten stamps are crushing this ore. It is the intention to keep the mill in operation continuously. The west vein will be developed from the 600-ft. level west from the main shaft, where there is over 50,000 tons of good grade ore available. Upon the development of this body the capacity of the mill should be maintained with 40 stamps in operation.

Jamestown, June 28.

A drilling contest was held at Sonora on July 4. It resulted as follows: Peyton and Dynon, 36⅝ in.; Pedro and Marcus, 36 7/16; Lumsden Bros., 36 1/16; Jacovovich and Vucasovich, 33; and Page and Bartlett, 24¾ inches.

COLORADO

The output of Colorado mines during 1914, according to figures compiled by Charles W. Henderson, of the U. S. Geological Survey, was $19,883,105 in gold, 8,796,065 oz. silver, 74,211,898 lb. lead, 6,639,173 lb. copper, and 96,774,954 lb. zinc (in terms of spelter and zinc in zinc oxide), with a total value of $33,460,126, compared with $18,146,916 gold, 9,325,255 oz. silver, 87,897,773 lb. lead, 7,227,826 lb. copper, and 119,346,429 lb. zinc, with a total value of $35,450,585 in 1913. This shows an increase of $1,736,189 gold, and decreases of 529,190 oz. silver, 13,685,875 lb. lead, 588,653 lb. copper, and 22,571,465 lb. zinc. In addition to the decrease in quantities of silver and the base metals, the falling off in average value for these metals caused a decrease in value of $768,230 silver, $973,238 lead, and $1,747,877 zinc.

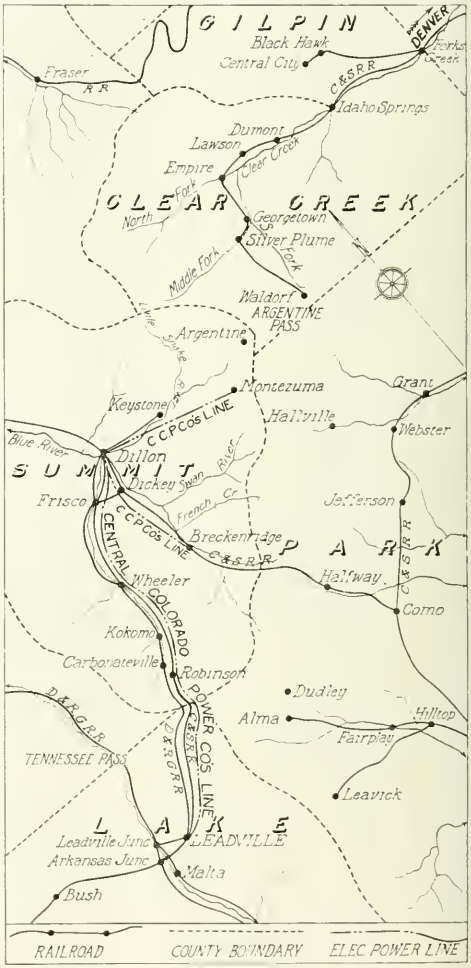
There was a total of 2,677,526 tons of ore treated. The largest tonnages were in the following counties: Teller, 939,423; Lake, 547,463; San Miguel, 495,942; Pitkin, 118,000; San Juan, 117,988; Ouray, 105,560; and Clear Creek, 101,366 tons. Cripple Creek produced 60% of the total gold yield, contributing $11,996,116. The output to date is $258,786,653.

Lake County (Leadville)

At 470 ft. in the Penrose shaft of the Down Town company, a station is to be cut for two electric pumps. The water in the mine will not be lowered further until this work is finished.——The zinc smelter is producing five tons of oxide daily, averaging over 75% zinc.——Thirty tons of $20 gold ore per day is again being extracted from the Big Four on Breece hill.——The Jacketts lease at Ibex No. 1 is shipping 100 tons of 40% carbonate ore monthly.——In the Birdseye district, G. Scheunemann and others are driving a 200-ft. adit at the Key mine. Other work has been done, and good results are expected.——Installation of electric motors at the Fortune mine in Big Evans gulch is completed.——The Mt. Champion mine is producing a good tonnage of rich gold ore. Three to four teams are hauling it.——The Ponsardin lessees so far have not arranged for the sale of their zinc sulphide recently discovered.——Extensive development continues at the St. Louis-Colorado property at Lackawanna. From the Lackawanna Belle, near by, rich gold ore is being shipped.

San Juan County

Shipments of ore and concentrate from the Silverton dis-



PART OF COLORADO.

trict in June totaled 109 cars. Of this, the Gold King dispatched 42; Iowa Tiger, 24; and Sunnyside, 22.——The American Oil Flotation Co. completed installing its plant at the Silver Lake mill at the end of June.——Snow is melting fast at the higher points, and prospectors will be able to start work soon, especially in the Gold Belt area.

San Miguel County

In the Colorado School of Mines *Magazine* for July, A. F.

Hallett describes the milling of vanadium ore at the Primos Chemical Co.'s plant at Vanadium. The ore contains from 1 to 3% vanadium. Five-ton wagons bring the ore two miles from the mine. After mixing with salt and iron sulphide, crushed in a jaw-breaker, and dried, it is reduced to 30-mesh in a ball-mill. McDougal and Wedge furnaces roast the crushed mixture. The vanadium is converted into sodium vanadate, soluble in water. The roasted material is cooled in conveyors, mixed with a weak solution of sodium vanadate, and run into 5 by 30-ft. vats, holding 100 tons each. The charge is leached with hot water from the furnaces for 36 hours. After the solution is cooled, it is transferred to three 50-ton precipitating vats, precipitation being by means of iron sulphate. The precipitate is recovered in Kelly presses, the mud resulting being dried in a Ruggles-Coles machine. The sacked product is then shipped to a refinery in Pennsylvania.

IDAHO

Ada County

Boise people, with J. W. Cox, own the Red Ledge copper mine on Deep creek. It is 16 miles from the terminus of the Homestead branch of the Oregon Short Line. An adit has been driven 400 ft. in ore. A great length averaged 4% metal. According to C. T. Barringer, the property can be best worked by steam-shovels.

Lemhi County

About 2000 tons of ore was sold during June by the Pittsburg-Idaho mine at Gilmore. The ore averaged 30% lead, 10 to 14 oz. silver, and a little gold.

Shoshone County (Coeur d'Alene)

About 5000 men are now employed in the Coeur d'Alene mines and mills.——On July 20 the Success company will distribute 4c. per share, equal to $60,000. Liquid assets total $264,600. Shipments in June were $168,803 zinc concentrate, and $12,066 lead concentrate.——At the old Keating mine near Wardner, the East Caledonia company has unwatered the 400-ft. shaft. Extensive development is to follow. The property is well equipped.——The Stewart dividend is 25c., instead of 30c., as given in the PRESS of July 10.

A drilling contest was held at Wallace on July 4, with the following results: Four teams were entered for the $500 prize. Kinsella and Leaf, from the Tamarack & Custer mine, won the first prize of $350, by drilling 34 11/16 in. in hard granite; Rossman and Haff, with 33⅞ in. to their credit, took second money; St. Germain and Morrison, the Osburn drillers, were third with 33⅜ in.; Stokes Bros. of Moon creek, drilled 32⅞ in. Entrance requirements demanded a residence in the district, thus insuring local men for the contest. In the 'mucking' contest, Campbell and Jones captured first money, eight teams competing. Their time was 1 minute and 10 seconds. Anitila and Jantii stood second with 1 minute and 25 seconds.

MICHIGAN

Houghton County (The Copper Country)

Copper output of the principal mines in June is estimated as follows:

Mine	Pounds	Mine	Pounds
Calumet & Hecla	7,600,000	Superior	356,000
Tamarack	635,000	Hancock	145,000
Osceola	1,933,000	Isle Royale	780,000
Ahmeek	2,629,000	La Salle	13,000
Wolverine	715,000	Winona	250,000
Mohawk	1,317,000	White Pine	730,000
Franklin	256,000	Quincy	2,057,000
Centennial	276,000	Copper Range	5,150,000
Allouez	850,000	Victoria	240,000
Mass	515,000		

The White Pine mill is treating about 800 tons of ore daily, mostly from No. 3 shaft. The stock pile has been removed. The ore is averaging 40 lb. copper per ton.——The Ahmeek mine is producing nearly 3500 tons of ore daily. The July output is expected to be 2,300,000 lb. copper.

MISSOURI

Jasper County

A statement has been issued by operators in connection with the miners' strike. At the meeting held last week, 90 operators employing 5831 men were in attendance. They claim that the strike was started by new men in the district. They intimidated old hands. The principal mines were paying machine-men $4 per 8-hr. shift at the time of the strike, 60% higher than in 1914. The operators will resume work when they are satisfied that there will be no interference. They will not recognize any union. They are willing to pay wages based on the price of ore.

The strike is over, and nearly all miners have returned to work. They have agreed to accept the wages paid at the beginning of the strike.

Owing to the strike two weeks ago the output of the Missouri-Kansas-Oklahoma region was 3000 tons less last week. The range of prices for zinc-blende was from $85 to $110 per ton. The output was as follows: blende, 4395 tons averaging $101.66; calamine, 94 tons at $58.51; and lead ore, 1168 tons at $59.87 per ton. The total value was $519,100.

At Lawton in Kansas, the new 300-ton mill of the Greenfield & Lockwood Co. was blown down on June 30.

MONTANA

Jefferson County

The adit of the Boston & Montana Development Co. at Elkhorn is in 2000 ft. Cross-cutting has been started for the Central and Idanha veins. The adit will be driven 1000 ft. farther later on.

Lewis and Clark County

The famous Drum Lummon property is again the subject of litigation. This time stockholders of the St. Louis Mining & Milling Co., owners of the Drum Lummon, are seeking to have a receiver appointed to handle the affairs of the company until other litigation in which the company is involved has been settled.

NEVADA

Churchill County

Ninety miles west of Fallon is the Bernice district, from whence Black and Solomon of San Francisco have arranged to haul 100 to 150 tons of antimony ore per month to Fallon, and then by rail to San Francisco. The ore is said to be high grade and free from impurities. The Chapman Smelting Co. has received several lots of it.

Esmeralda County

At San Francisco on July 8 a final settlement was made regarding the Merger Mines Co. The directorate will be reorganized so as to give all interests representation.——At 600 ft. in the Yellow Tiger, it is thought that a winze has been found in which rich ore was opened years ago.——At the Atlanta, the dump at the Merger shaft is growing steadily. Ore worth $42.90 per ton was cut last week in incline raise 1011-A on the vein above 1750 ft. in the Union Jack claim. At 1660 ft. the drift is in 150 ft., showing quartz for the full width.——In June the Florence mine shipped 600 tons of $20 ore.——At the Jumbo Extension six faces are yielding 100 tons of ore per day. The mine continues to develop well. The miners' change-house has been fitted with showers. A connection has been made with the Goldfield Consolidated company's fire system.

At the Fourth of July celebration at Goldfield the following are the results of the drilling contest: doubles won by Collins and Lindquist, 40¾ in., prize $500; second, Hughes and Jelik,

39 1/16 in., $200; third, Schram and Olson, 38 3/4 in., $25 in merchandise. Singles, first, Lindquist, 23 7/8 in., $250; second, Brooks, 19 3/8 in., $100; third, Malli, 18 3/16 in., $12.50, in merchandise.

HUMBOLDT COUNTY

At about 125 ft. from the Nevada Packard north end line, the Packard North Extension has cut 9 ft. of good ore. It is supposed to be an extension of the former's vein.

At Willard, the Faucett-Campbell lessees at the Sheepherder claim have shipped 25 tons of ore to smelters.——Two veins have been cut in the Honey Bee. This property has sent out three cars to date. Results are very satisfactory.——Ore has been cut in the Finland No. 2 adjoining. An adit is in 150 ft. ——Two to seven feet of $30 ore has been cut in an upper adit of the Borland-Hunter lease.——Lessees at the Finland have opened rich ore.——At the Enterprise, 1000 ft. from the Henry Bee, the adit is in 75 ft. A carload of ore is at the mill. ——Numerous other lessees are meeting with encouraging results.

LINCOLN COUNTY

It is stated that shipments of tungsten ore are being made from the Silver Comet mine in the Pioche district. Boston people are interested.

NYE COUNTY

(Special Correspondence.)—The Round Mountain Mining Co. is hydraulicking with two monitors, washing from 1200 to 1500 cu. yd. of gravel daily. Tests have shown a minimum gold content of $1 gold per yard. Operating costs are approximately 30c. Net earnings are estimated by the management at from $33,000 to $39,000 per month, including profits from quartz-mining operations. Sluicing can be conducted during five or six months of each year, after which the reduced water supply will cut down production by 25 to 50%. The deposit was briefly described in the PRESS of June 19. Present earnings are at the rate of 2 1/2c. per share per month. The company has paid dividends aggregating $363,000, and it is announced that distributions will be resumed by the end of this summer.

Round Mountain, July 10.

Owing to the holidays the Tonopah district produced only 8264 tons of ore worth $174,712 during the past week.——A machine-shop is to be erected at the Jim Butler mine, where developments continue to be excellent.——Lessees at 535 ft. in the Midway will probably produce a good deal of ore before long.——A new trial in the Jim Butler-West End case was denied last week by Judge Averill.

SOUTH DAKOTA

LAWRENCE COUNTY

For some time past tungsten ore has been sacked at the Wasp No. 2 mine, a small vein being worked during the extraction of the low-grade gold ore. Several shipments have been made, the last two carloads on July 3 being valued at over $300 per ton. More attention is to be paid to mining this valuable mineral. Other properties in the district are said to contain similar ore.

UTAH

BEAVER COUNTY

During the second half of June the Moscow company shipped 14 cars of lead-silver ore. Eight of these netted $1600 per car. The Cullen shaft is to be sunk 300 ft. deeper. A double-drum electric hoist is to be ordered. About 60 men are employed from 400 to 1175 ft. depth. The mine, in charge of G. S. Wilkin, is in good condition.

GARFIELD COUNTY

On Coyote creek stibnite and oxidation products occur in flat lying deposits in sandstone and conglomerate. The ore is found in lenses remarkably free from gangue; these have been worked at irregular intervals since 1880. In 1906 the Utah Antimony Co. erected a concentrator and maintained a fair production for a few years thereafter.

SALT LAKE COUNTY

At Midvale the U. S. Smelting, Refining & Mining Co. is enlarging its mill. The present concentrators and Huff electrostatic plant can treat 350 tons per day. This will be increased to 600 tons. About $75,000 is being spent in improvements. The copper furnaces are still idle, having been so for eight years.

The Bingham & Tooele Mining Co. has resumed driving its adit. It will be 2000 ft. long, where it will be at a vertical depth of over 1500 feet.

SUMMIT COUNTY

Park City mines last week shipped a total of 2836 tons of ore.——The holdings of the Grasselli Chemical Co. at Park City have been bonded to C. C. Broadwater of the Merrill Metallurgical Co. of San Francisco. A large tailing dump is to be treated by the lessees.

WASHINGTON

PIERCE COUNTY

Owing to the increased deliveries of copper ore from Alaska, the A. S. & R. Co. contemplates enlarging its smelter at Tacoma.

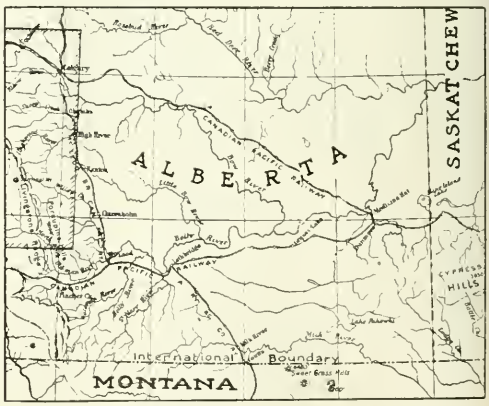
STEVENS COUNTY

Last week the Spokane Chamber of Commerce-Mining Men's Club visited the Chewelah district. At the United Copper mine it was seen that the ore-shoot had been opened for 1225 ft., where it is from 2 to 20 ft. wide. Two raises have connected the 600 and 1000-ft. levels. Sinking to 2000 ft. will be started in September. The oil-flotation process at the mill is recovering 90% of the metal-content, and 95% is expected later. By August 1 the plant will treat 300 tons of ore per day. Generally the property is in excellent order.

CANADA

ALBERTA

The correlation and geological structure of the Alberta oil-fields is discussed by D. B. Dowling in Bulletin 102 of the A. I. M. E. The principal difficulty experienced in correlation



OIL DISTRICTS OF ALBERTA AND MONTANA.

was in connection with the measures known as the Montana group. In Dakota and Manitoba this consists of a series of shales of marine origin. In the eastern Montana section two sandstone members appear, leaving a shale member at the top, and another near the bottom. In the section in western Mar-

tana the lower shale is not found, and the upper one is reduced in thickness. The eastern and western sections have been correlated by tracing them to the international boundary, and making a connection by means of the formations on the Canadian side. The Dakota sands and Colorado shales are described, including their occurrence in the Sweet Grass hills. Structure and development of the region is also discussed.

British Columbia

The smelting plant of the British Columbia Copper Co. at Greenwood is described in Bulletin 103 of the A. I. M. E. up to the outbreak of war. It was successfully smelting in one 51 by 240-in., and two 51 by 360-in. blast-furnaces the lowest-grade copper ore of all plants in America. In order to do so, it had to run at very high efficiency, which necessarily required a large tonnage per square foot of hearth area, together with the minimum amount of labor and other costs. The furnaces smelted daily 2250 tons of ore (6.62 tons per sq. ft. of hearth area), containing 0.85% copper, at a smelting cost of $1.18 per ton. The entire plant required 130 men to operate it and keep up repairs, showing a labor efficiency of about 17.5 tons per man per day. With illustration and plans the paper covers 20 pages.

The Standard Silver-Lead company's new contract with the Trail smelter makes a reduction of $1.333 per ton in the treatment charge and receives 5½c. per pound for lead, against 4c. under the former agreement. The total freight and treatment charges are $8 per ton.

The Fisher Maiden zinc-lead-silver mine, near the Standard, has been leased to the Lippert Investment Company.

The Quatsino Copper Co., operating on Vancouver island, has acquired under bond some more property for $100,000. The company is spending up to $10,000 per month in development of its claims. A railway will be constructed from the mines to June landing on Quatsino bay.

Ontario

During the first quarter of 1915 the McIntyre mine yielded gold worth $177,261, from 23,445 tons of ore, an average of $7.57 per ton. Costs were $5.02 per ton, and profits were $59,482. The average value is $1.43 lower than in 1914, when 62,209 tons was treated with a profit of $158,748. The second quarter should show a better result than the first. Development continues from No. 4 and 5 shafts. Sinking is still under way.

The report of the Buffalo Mines Co. covers the year ended April 30, 1915. The manager, T. R. Jones, stated that development amounted to 2415 ft., and 40,363 sq. ft. of stoping. There was broken 45,237 tons, of which 39,455 tons were hoisted. Reserves of mill ore provided 12,212 tons. Ore reserves are estimated at 16,097 tons broken, and 26,000 tons in place. The ore contains about 20 oz. per ton. The mill treated 51,667 tons, averaging 19.5 oz. per ton. Including sales of silver and metal on hand (125,000 oz.) the output was 822,793 oz. The income was $372,260, and profit $79,690. No dividend has been paid since July 1914; the total to date is $2,807,000.

MEXICO

Sonora

A flotation plant is to be installed at the Cananea Consolidated mill by David Cole of the Arizona Copper Co. This will reduce losses in the tailing.——When the Nacozari railway resumes, the Nacozari Consolidated company will start shipments of zinc-lead-copper-silver-gold concentrate. This will probably go to El Paso, according to the general manager, J. G. Alexander.

The Calendar of the University of Western Australia, at Perth, for 1915 consists of 361 pages. This institution is one of the newest universities, commencing actual work in 1913. There are eight professors, four lecturers, and four assistant lecturers. The third term begins on August 30. Full instruction is given regarding courses, examinations, and degrees.

PERSONAL

W. H. Weed is at Butte.

Charles Janin is in Montana.

Scott Turner is at Petrograd.

W. B. Winston has gone to Denver.

William Braden has returned to Chile.

Howard D. Smith is at Oatman, Arizona.

J. T. Milligan is here from Cripple Creek.

J. W. Malcolmson is here from Kansas City.

H. H. Webb is expected here from New York.

C. A. Demand has arrived here from Mexico.

Howland Bancroft is at the Copley Plaza hotel, Boston.

Stephen Birch is at the Kennecott copper mine, Alaska.

Rensselaer H. Toll is in charge of a mine at Carson Hill, California.

E. S. McCurdy has returned from San Bernardino to Angels, California.

H. C. Hoover and M. K. Shaler have returned to London from Belginm.

W. J. Loring is making a visit of inspection to the Plymouth mine, California.

Bernard M. Baruch, of New York, has been visiting the Utah copper mines.

H. C. Goodrich, chief engineer to the Utah Copper Co., is on a holiday at Los Angeles.

J. Parke Channing, who has been in attendance at the flotation suit, has gone to Montana.

Edwin C. Holden, professor of mining in the University of Wisconsin, has been visiting the Exposition.

Bert Lunceford, for eight years superintendent of the Tom Reed mine, at Oatman, Arizona, has resigned.

F. R. Lynch succeeds W. L. Honnold as local manager for the Consolidated Mines Selection Co. at Johannesburg.

W. L. Wotherspoon, mechanical engineer to the Canadian Mining & Exploration Co., has been visiting the copper mines of the Southwest.

W. L. Honnold left Johannesburg on May 27, having resigned numerous important appointments previous to his return to the United States, after 13 years of honorable and profitable sojourn in South Africa. At the meeting of the Brakpan, Springs, and Transvaal Coal Trust companies he received a cordial valedictory. As consulting engineer, and subsequently managing director and chairman, he is given credit for the success of these important mining enterprises. Mr. Honnold has been on the Rand 13 years; he is a graduate of the Michigan College of Mines. We venture to add that Mr. Honnold's departure was the cause of added regret because it involved that of his capable and charming wife.

Schools and Societies

The University of Pittsburg has issued its announcement series for the School of Mines for 1915-1916. The first division of the semester commences on September 27. The bulletin describes the equipment, admission, courses, degrees, and faculty.

The A. I. M. E. meets at San Francisco on September 16, 17, and 18. There will be excursions to oilfields, dredging, deep mining, and hydro-electric plants. Papers accepted for presentation include five on mining, one on mining law, six on geology, three on milling, four on copper, eleven on gold and silver, four on lead, five on petroleum and gas and four on iron and steel, and four miscellaneous. A joint session will be held with the American Electro-Chemical society. A branch of the A. I. M. E. has been organized at Bisbee, Arizona.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, July 15.

Antimony	35 —35¾
Electrolytic copper	20½—20¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$95
Spelter	22 —22¼
Tin	41 —42½
Zinc-dust, 100-kg. zinc-lined cases	38

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, July 15.—The copper market is lifeless; lead is very uncertain; spelter is quiet with freer offerings.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
July 8	19.50	June 2	18.67
" 9	19.50	" 9	19.39
" 10	19.50	" 16	20.12
" 11 Sunday		" 23	20.00
" 12	19.50	" 30	20.00
" 13	19.50	July 7	19.75
" 14	19.50	" 14	19.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.69	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended June 26 totaled 7,171,707 lb., worth $1,294,935. Of this, England took 3,859,650; France, 2,477,231; Denmark, 672,000; and Holland, 110,499 lb. Imports of all kinds amounted to 5,656,831 lb., valued at $797,158. Of this, 1,933,250 came from Chile, 1,781,212 from Japan, and 1,129,372 from Peru.

Stocks in England and France on June 15 were 25,674 tons. There was also afloat from Chile to Europe 550 tons, and 4000 tons from Australia.

Lake Superior copper mines are now producing at the rate of 324,000,000 lb. per year, 40% greater than in 1912, a normal year. In a few weeks the output will be at the rate of 360,000,000 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
July 8	47.50	June 2	49.40
" 9	47.62	" 9	49.35
" 10	47.75	" 16	49.31
" 11 Sunday		" 23	48.97
" 12	47.62	" 30	48.40
" 13	47.37	July 7	48.10
" 14	47.50	" 14	47.56

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57 58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	51.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec	49.27	....

Silver quotations during the past week are self-explanatory. On July 10 about 500,000 oz. left San Francisco for China. The Nipissing at Cobalt last week shipped 249,559 oz. to London via New York. Exports from London to June 23 of 1915 and 1914 were worth £2,619,000 and £3,915,000 respectively, about 13,000,000 oz. less. Stocks in London total about 17,000,000 oz. Advice from London dated June 23 states that offerings were on a rather larger scale, but the support, mainly from India, was limited. The rainy season opened favorably. Later rains are of far more importance to the Indian crops, so the price of silver has not been affected yet.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June 16	90.00	June 30	95.00
" 23	95.00	July 7	95.00
		" 14	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60 00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38 60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July 8	5.75	June 2	4.69
" 9	5.75	" 9	5 44
" 10	5.75	" 16	6.66
" 11 Sunday		" 23	5.82
" 12	5.70	" 30	5.55
" 13	5.65	July 7	5.75
" 14	5.65	" 14	5.71

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

According to a United States commerce association at Berlin, lead in Germany early in June was 5.83c. per pound. The monthly output was about 13,000 tons.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
July 8	22.80	June 2	22.10
" 9	22.50	" 9	26.17
" 10	22.25	" 16	22.83
" 11 Sunday		" 23	18.71
" 12	22.00	" 30	20.58
" 13	22.00	July 7	22.10
" 14	22.00	" 14	22.26

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	....
Feb.	39.76	37.23	Aug.	30.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

According to L. Vogelstein & Co., the tin position at June 30 was just 100 tons different to that of the same date of 1914, namely, 15,927 and 16,027 tons supply, although there was an alteration in holdings as follows:

Country.	1915.	1914.
London	6,136	10,737
Holland	62	1,188
United States	9,729	4,102
	15,927	16,027

Of the totals, 11,166 and 7251 tons, respectively, was afloat. This change shows the magnitude of the American interest in tin supplies, the War resulting in shipments direct to home ports instead of via London. On the whole, considering what the market has been through, the situation must be regarded as favorable.

ANTIMONY

The market has weakened a little under the influence of slightly heavier arrivals, but the spot price still ranges from 36.25 to 36.75c. Otherwise no feature of interest is observed.

ALUMINUM

This market is strong at 32 to 33c. on new business.

Eastern Metal Market

New York, July 9.

All of the metals, with the exception of spelter, have experienced a dull and uninteresting period since the last report. In spelter there was no great amount of buying, but there was enough in a steady, quiet way to maintain quotations. Resale lots of copper have appeared at lower prices, but despite the concessions consumers have been almost inactive. Lead has had its ups and downs, but most of the cheap lead has been taken up by dealers, some of whom predict 6c. lead in the near future. Tin has been dull throughout the week; consumers are well supplied, the large arrivals in sight have weakened the market. Antimony is a trifle weaker, but prices are nevertheless well-sustained. Aluminum is strong.

The steel industry continues to make big gains, reports from every direction being optimistic. Another large gain in pig-iron production was shown in June. In 30 days the output was 2,380,827 gross tons, or 79,361 tons per day, a gain of 6346 tons daily over May. Of the increase, steel-works furnaces contributed nearly 4500 tons. The month brought 12 additional furnaces into blast. The War business is steadily gaining greater headway. The American Can Co. is the latest great corporation to consider entering contracts for supplying munitions of war. The total number of companies now engaged in that work in the United States exceeds 100. The number supplying miscellaneous supplies to the warring countries is many times greater. It is interesting to note that some of the shell contracts now offered have three years for completion. War business with Italy is now in prospect. A commission from that country is now in the United States.

COPPER

Sales have been few and small, and the entire attitude of the market has been one of waiting. Naturally, under such conditions, prices have softened. The producing interests continue to quote around 20c., full terms, for electrolytic, but second-hands have offered and sold copper as low as 19.50c., cash, New York. The London market has been weak and irregular for some days, with especially sharp declines in standard or 'paper' copper. Between spot standard and electrolytic there is a difference of £15 17s.6d. Yesterday there were reports that a few round lots had been purchased by France on approximately the basis of 19.87½c. cash, New York, but if such sales were made they are yet to be verified. The consumption for purposes of war continues heavy and must become heavier as the output of munitions increases. The consumption of metal in the arts of peace is far from satisfactory, though some improvement has been shown in this direction of late. High-grade Lake is quoted at 22.50c., with less desirable grades quoted down to 20c. Exports July 1 to 10 total 3977 tons.

ZINC

A steady business has been done in spelter, both in nearby deliveries and in positions running into 1916, and this fact together with the difficulty in finding prompt metal has sustained quotations and within the last day or two caused them to strengthen. On July 7, for instance, sales were made at 22.50 to 23c. In some ways the present high price is hurting business at large. There are the galvanized-sheet mills which have suspended operations pending a return of spelter prices to more normal levels. Not only is the situation bad for mill labor, but there are cases where the mills have held up certain contracts for their needs until they can resume business. Then again, with galvanized sheets at a high figure their use is minimized and the jobbers suffer a falling off in their trade. Many complaints are heard. Brass-mill spelter is quoted at about 24c. for August delivery, and 25c. for last quarter. Very choice brands are practically out of the market. Some zinc concentrate produced from ore mined in the northern part of the state of New York is now being shipped from St. Lawrence county. The shipments have not reached large proportions. In the first 10 days of this month exports amounted to 1008 tons.

LEAD

An easier trend has developed in the past two or three days and, while the A. S. & R. Co. has held to its quotation of 5.75c. New York, other sellers have offered concessions of 10 to 15 points. Prior to this development the market had gained in strength, and the re-sale lots which had made prices so irregular were bought up. It is significant that much of the buying was on the part of dealers. Export sales are blocked by the fact that the London price is below New York parity. There are those in the trade who predict 6c. lead before very long. Exports up to July 10 were 642 tons.

TIN

The course of quotations for spot Straits has been almost steadily downward. It was quoted July 8 at 38.50c., and there were lots to be had at a still smaller figure. The demand has been light and almost entirely for small lots of spot. The fact is that consumers are well supplied under the contracts they entered some weeks ago. The lack of demand and consequent pressure to sell brought about the decline referred to. A feature of the situation is the large quantity afloat, 7150 tons. The arrivals this month aggregate 950 tons.

Holdings of Guggenheim Exploration

As the Guggenheim Exploration Co. had nearly $12,000,000 surplus, a large special distribution was expected. So far, however, no announcement has been made. It was rumored that the company had been liquidating some of its holdings of copper shares with intentiou of distributing the proceeds among stockholders. It is authoritatively stated that not a share of any of its holdings has been sold. The company's most valuable asset is its 404,504 shares of Utah Copper. Market value of this stock on July 2 was approximately $27,500,000, or more than $2,000,000 above the value of all other stocks held by the Guggenheim company. Yukon Gold shares stand next in value on account of the large holdings, which exceed 2,842,000 shares.

A tabulation of the company's assets made a few weeks back, when the securities market was higher, gave a book-value to Guggenheim shares of $78.90. On the basis of the July 2 market quotations the book-value is lowered to approximately $77.70, the market prices being put at round figures for convenience of calculation. Roughly the distributable value of assets has declined $1,000,000 by the stock market's recession, the value now being $64,627,479 for the 831,732 shares of Guggenheim Exploration outstanding. Holdings are as follows:

	Shares.	Approximate price.	Market value.
Utah Copper	404,504	$68	$27,506,272
Chino Copper	97,750	45	4,398,750
Ray Consolidated	154,300	24	3,703,200
A. S. & R. com	69,500	79	5,490,500
Smelters Securities pfd. A	33,656	84	2,827,004
Yukon Gold	2,842,625	2¾	7,817,218
Alaska Yukon properties and equipment			1,047,262
Cash and demand loans			*11,837,273
Total			$64,627,479

*December 31, 1914.

A new high record in income will be set this year.

BOOK REVIEWS

The Overland Route: a Guidebook of the Western United States. Bulletin 612. U. S. Geological Survey. Ill. P. 244. Price, $1.

This is one of four books to be issued by the Geological Survey with a view to giving scientific information to travelers on the transcontinental lines of railroad. They are based on the data contained in previous geological reports, plus unpublished information, supplemented by a special field-examination by officers of the Survey. The present volume is credited chiefly to Messrs. Willis T. Lee, Ralph W. Stone, and Hoyt S. Gale. No less than 29 accurate maps are interleaved, besides numerous photographs, geological sections, and sketches. The foot-notes are so absorbing that the reader lingers on his way, as at one of those Harvey "eating houses" (what a term!), or railroad-hotels, that used to cheer the traveler in the days before the pretentious Pullman 'diner' came into use. From Council Bluffs to San Francisco the story runs. Lincoln stipulated that the Union Pacific railroad should begin on the Iowa side of the Missouri river, so that the railroad company had to build an expensive, but extremely useful, bridge. At once the geologist gets our ear, for he tells us about the fossils of pre-historic animals uncovered in the gravel through which the railroad grade has been cut. Before we finish with that absorbing foot-note we have gone to Siberia and seen the real fleshly mammoth that was discovered there, held in cold storage by the ice for years untold. Nebraska is "a State without a mine," as if to emphasize the fact that the other states traversed are so rich in mines: Colorado, Wyoming, Utah, Nevada, and California. The mere names trumpet their fame as mineral regions. In the earlier hours of his journey, the traveler's attention is directed to the boulders and vagrant fragments of rock that indicate deposits of glacial origin; whereupon his imagination is quickened by a brief outline of the Great Ice Age and he is given a map that marks the limits of the ancient ice-sheet. From the car-window he sees the southern fork of the Overland Trail that the railway followed and that the western part of the Lincoln Highway is also to follow. This transcontinental automobile road will be 3389 miles long and will traverse 13 States. The work of improving the road is under way. Beyond Cheyenne the sale of fossils suggests the great finds of these beautiful relics of a by-gone period that have been made in the bluffs of the Laramie foothills. A note, with illustrations, describes the extinct animals that flourished in the Miocene period. Then come the coal-fields, with Green River, from which Major Powell started on his famous expedition to explore the canyons of the Colorado. In Utah the geologic history of the Salt Lake arrests the traveler, who is told a great number of interesting facts in such an engaging way that he forgets that it is science that he is imbibing in large draughts. Indeed, the note on Salt Lake is an admirable précis of accurate information. As the railroad nears the various mining centres, the guidebook tells a little of their history and production; it outlines the salient facts in the civic development of this vast mineral territory; it sketches incidents rich in human interest. Many of the photographs are beautiful; some of them are accompanied by diagrams that elucidate the relation of the landscape to the underlying geology. It is an excellent performance. Those who expect to go 'overland' should read this book as an instructive preparation for intelligent travel; those who have crossed it so many times that they have ceased to count their traverses will rejoice that so much useful knowledge should now be readily available to the observer along the well-worn trail that the buffalo, the Indian, the fur-trader, the Mormon, the immigrant, the train, and the automobile have followed successively.

Materials of Construction. By Adelbert P. Mills. P. 658. Ill., index. John Wiley & Sons, Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $4.50.

This work is primarily a text-book, but, notwithstanding the necessarily brief treatment that must be given to each subject, has also considerable value as a book of general reference. The materials of masonry construction are first considered, the chapter headings being Gypsum Plasters, Quicklime, Hydrated Lime, Puzzolan Cements, Natural Cements, Portland Cement, and Concrete. The production, properties, and uses of each material are briefly discussed. Stone and then brick masonry are then considered, the latter subject including special kinds of brick, terra cotta, and tile. Iron and steel are naturally given the largest space in the book. Methods of manufacture of the different grades of iron and steel are discussed and considerable space devoted to the effect of different proportions of carbon and other foreign substances on the properties of the finished product. In this and also in several succeeding chapters these effects are shown graphically in a number of diagrams. A chapter is devoted to the various special alloy-steels for which the needs of certain modern machinery has created a demand. The different non-ferrous metals that are of importance in construction, together with their alloys, are briefly considered. The last chapter of the book is devoted to timber, the data contained being mainly abstracted from the many government publications on the subject. While the volume as a whole contains little that has not already been said in other books, yet it is several years since all this information has been collected under one cover, and in the meantime, considerable progress has been made both in the production and the use of many structural materials. The book is well illustrated and there are a number of useful tables and diagrams included in the text.

Design of Steel Bridges. By F. C. Kunz. P. 461. Ill., index, and 52 plates. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $5.

This volume is intended more as a reference and hand-book for the practising engineer than a textbook for the student, although the theoretical foundation for design is considered as well as practical details. The first chapters take up the forces acting on a bridge, and then stresses in trusses and in the bracing of simple spans is considered. The various types of bridges are classified and their principal characteristics described. A chapter is devoted to floor-design, both of railroad and highway bridges. Beam and plate-girder bridges, simple truss bridges, and skew bridges are discussed in order, and data are also given on weights of simple span bridges. Viaducts and elevated railroads are discussed, and then draw-bridges and turntables. Arch-bridges both of the two and the three-hinged type are discussed, and also cantilever bridges. Some space is devoted to a general discussion of long-span bridges, although suspension bridges are not thoroughly discussed. The appendix contains some tables and other useful information, and there are 52 full-page plates, most of them showing details of bridges actually constructed. There are also a number of valuable tables and diagrams scattered through the main body of the text.

The Railroad Taper. The theory and application of a compound transition curve based upon thirty-foot chords. By Lee Perkins. P. 356. Illustrated. John Wiley & Sons., Inc., New York, 1915. For sale by the Mining and Scientific Press. Price, $2.50.

This is the second railroad book to be reviewed within the past few weeks. As its name implies, the subject is technical and mathematical, and of value to railroad construction engineers. Elevation of the outer rail on a curve is of great importance. The work is an extension and elaboration of that published by W. Hood, some years ago. The book includes 294 pages of tables.

COMPANY REPORTS

ALASKA MEXICAN GOLD MINING COMPANY
ALASKA TREADWELL GOLD MINING COMPANY
ALASKA UNITED GOLD MINING COMPANY

Reports of these companies for the year ended December 31, 1914, are to hand. They contain a great deal of interesting information, and plans of underground workings. All being under the general superintendency of P. R. Bradley, the reports will be considered together. The year's results may be summarized as follows:

Results of operations.	Mexican.	Treadwell.	United—Ready Bullion.	United—700-Ft. mine.
Men employed	159	733	246	
Average wage per day	$3.28	$3.51	$3.49	
Development in Mexican, feet	1,251	3,723	4,275	8,201
Development in 700-Ft. mine, feet	1,263	840	.....	.....
Central development, feet	*2,041	*2,041	.....	*2,041
Diamond-drilling, feet	67	2,581	2,361	1,923
Underground cost, per ton	$1.019	$0.6896	$1.055	$1.23
Mine samples, number	1,693	3,860	1,880	2,083
Average value per ton	$2.93	$2.82	$3.90	$2.60
Reserves in place, tons	327,426	6,604,086	1,835,650	2,359,495
Reserves broken in stopes, tons	361,312	555,167	308,412	182,982
Total reserves, tons	688,738	7,159,253	2,144,062	2,542,477
Average value per ton	$2.68	$2.48	$2.85	$2.22
Reserves in previous year, tons	816,882	6,093,308	1,708,662	1,281,475
Stamps dropping	120	540	**120	120
Steam power used, days	135.25	†118.66	126.09	156.64
Water power used, days	223.70	†236.53	225.04	199.55
Electric power used, days	.....	‡195.37 ‡133.89	.....	.....
Duty per stamp-day	5.42	†4.49 ‡5.34	5.53	5.27
Ore crushed, tons	233,457	910,285	233,100	225,214
Gold by amalgamation	$238,757	$1,264,945	$282,037	$230,510
Concentrate treated, tons	4,341	19,325	5,701	4,409
Gold by cyanidation	$270,267	$1,102,617	$252,371	$200,874
Total recovery	$509,024	$2,367,562	$534,408	$431,384
Milling cost per ton	$0.2457	$0.2572	$0.2641	$0.2638
Concentrate cost per ton of ore	$0.0798	$0.0850	$0.0933	$0.0797
Bullion charge per ton	$0.0082	$0.0113	$0.0100	$0.0082
Total costs per ton	$1.4705	$1.1908	$1.4697	$1.6219
Profit	$170,020	$1,351,403	$191,827	$66,112
Balance from 1913	$10,245	$48,230	$10,555	
Amount available	$180,265	$1,399,633	$258,493	
Dividends (4) (6) (4)	$144,000	$1,100,000	$162,180	
Depreciation	$25,451	$250,953	$81,153	
Balance for 1915	$10,814	$48,680	$15,160	
Returns to date:				
Ore treated, tons	4,053,903	14,778,074	3,428,903	1,856,753
Gold recovered	$10,947,737	$26,332,186	$7,134,914	$3,952,100
Yield per ton	$2.70	$2.46	$2.08	$2.13
Operating profit	$3,997,944	$17,060,377	$1,687,771	$962,598
Operating cost	$1.72	$1.31	$1.59	$1.61
Dividends	$3,417,381	$14,885,000	$1,738,930	

*Done jointly with the other companies. **Now 150 stamps. †240-stamp mill. ‡300-stamp mill.

It will be noticed in the above table that the three companies contributed to the Central development work. This included operations at 1750, 1950, 2100, and 2300 ft. The Central shaft was sunk 83 ft., making it 2354 ft. deep in waste. The Central hoisting and crushing-plant, the former breaking down on June 19, 1915, worked throughout the year. It handled 1,097,770 tons of ore and 6247 tons of waste. New equipment is being installed in the Central steam-electric power-plant. When complete, its capacity will be 4750 kw. The cost was $183,562.

At the Nugget Creek hydro-electric plant $39,000 was spent on the dam and transmission-lines. An addition to the Sheep Creek hydro-electric plant was completed. Large motors were installed at hoists and mills.

The cyanide-plant treated 33,775 tons of concentrate from all the mills. The recovery was 96.86%, at a cost of $2.76 per ton of concentrate treated.

The assay-office made 44,224 determinations at a cost of 23.6c. per sample.

A new general office was erected, extensive alterations to the store, and two new warehouses were built on the Treadwell wharf. The fire department and committee of safety showed their usual interest in their work.

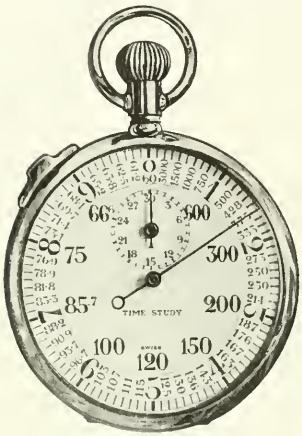
In Bulletin 103 of the A. I. M. E., W. P. Lass describes the electric furnace for gold refining at the cyanide plant. From three to four tons of gold precipitate, worth $40,000 to $60,000 per ton, is produced from the concentrate per month.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Time-Study Watch

The Time-Study watch, of Mortimer J. Silberberg, Peoples Gas building, Chicago, a photograph of which is shown, gives direct reading in operations per hour, eliminating mental and pencil computation. The dial is divided into tenths and hun-

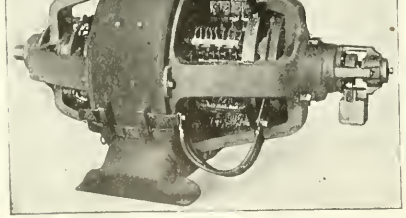


TIME-STUDY WATCH.

dredths of minutes. There are also figures spaced two-hundredths of a minute apart, distinctly legible, that indicate at any point of elapsed time exactly what the corresponding output per hour is. The watch is very convenient for observations of all kinds of work where the study of time taken is necessary.

Rotary-Converters in Coal Mines

According to the Westinghouse Electric & Manufacturing Co. of Pittsburg, it is interesting to note the favorable im-



WESTINGHOUSE ROTARY-CONVERTER.

pression being made by the rotary-converter in coal mining, particularly since the manufacturer has developed the new commutating-pole machine in smaller sizes. One of the chief troubles in mining work, particularly with small rotaries, has been commutation, because the mining load varies anywhere from 10% of full load to 100% overload in a very short time. With the non-commutating pole rotary, it was necessary to shift the brushes with the change in load, or sparking and damage to commutator would result. This damage to commutator would end finally in short-circuited coils and burnouts. Since the application of commutating-poles, a machine normally designed for 35° rise in temperature at full load, will carry a 50% overload for 2 hours with a rise not exceeding 55°, and a momentary overload of 100% without the least sign of sparking, this better performance being due to the application of commutating-poles. With this design the brushes are set on the neutral point and fixed there, and the varying loads have no effect whatsoever in-so-far as sparking is concerned.

An order from the Stonega Coke & Coal Co., Virginia, was for twenty-four 150-kw. converters, to be placed in 12 underground sub-stations. Another installation, above ground, is of 200 kw. at the Conemaugh Smokeless Coal Co., Pittsburg. The accompanying photograph shows this machine. Three sizes of this type are built. Another type is made in 300 and 500-kw. sizes.

Commercial Paragraphs

The Anaconda Copper Mining Co. is preparing to install 24 more of the 10-ft. diameter HARDINGE mills. This makes a total of 44 out of a contract which it made the first of this year for 60 of these machines.

A leaflet issued by the DEISTER CONCENTRATOR Co., Fort Wayne, Indiana, shows facsimiles of telegrams from the Stearns-Roger Manufacturing Co. of Denver, ordering tables for the Ajax mill at Cripple Creek.

Bulletin E-36, superseding E-29, of the CHICAGO PNEUMATIC TOOL Co., 1010 Fisher building, Chicago, deals with the various Duntley electric grinders. They are useful in foundries, machine-shops, structural shops, and for grinding rails on railways. No. 6 is for external and internal grinding.

'Centrifugal pumps and centrifugal pumping units' is the title of Bulletin 1632, 44 pages, of the ALLIS-CHALMERS MANUFACTURING Co., Milwaukee, Wisconsin. Single and multi-stage motor or engine-driven pumps up to 72 in. are made. One mine pump is a solid bronze 10-in. 10-stage machine for lifting against high heads.

The NORMAN B. LIVERMORE & Co., San Francisco, advises us that a Chalmers & Williams adjustable quick-discharge tube-mill has been sold to the California Slimes Extraction Co. at Sutter Creek, California. This will re-grind tailing from some Mother Lode mills. A 24-in. Symons disc-crusher has been sold to the Original Amador company at Amador City. This will reduce the present crusher output to a size for the tube-mill.

The WESTERN ELECTRIC Co., New York, sends us the following circulars: 'The Telephone in China,' (installation at Pekin, Tientsin, Changsha, and Tsinanfu, with 4100, 2450, 600, and 450 subscribers stations respectively in January 1915, all of W. E. manufacture); 'Telephone Cable in China,' (illustrating laying W. E. cable, under direct supervision of W. E. engineers, in Changsha); and details of the awards of the company at the Exposition at San Francisco. The Grand Prix was given for the exhibit as a whole, three gold medals for telephone equipment; two bronze medals for mine-rescue and mine telephones; and silver medals for various electrical devices by companies closely identified with the Western Electric Company.

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

THE American Institute of Mining Engineers meets in San Francisco on Thursday September 16 and for three days thereafter.

MENTION of advertisements on this page is contrary to our custom, but we shall be forgiven, and not misunderstood, by our readers if we direct their attention to an advertisement of smelter-brooms made by the blind, appearing on page 24 of our advertising annex.

PROHIBITION of exports of copper from England, by order of the British government, has eliminated the international influence of the London Metal Exchange in regulating the price of the metal. Thus the American copper producers are now in a position to dominate the market.

MANGANESE production in Russia has been greatly hampered by the War. Two years ago nearly a million tons per annum was exported from the Caucasus, about half of it going to Germany. What the German steel-makers are doing to secure an alternative supply has not been made public.

CURRENCY problems in Mexico threaten to become more pathetic than humorous. In our mining news we give an outline of sundry projects for regulating the paper money issued in Sonora. This should be read in conjunction with the special article on 'Conditions in Sonora' appearing in our last issue.

WORK at the Gary plant of the Illinois Steel Corporation is now on a full-time basis, for the first time in two years. Shipments of iron ore from the Lake Superior district during June show an increase of almost 20% over last year. These evidences of increased activity presage the return of industrial prosperity.

WORKINGS in the Morro Velho mine, in Brazil, have reached a vertical depth of 5826 feet, making it the deepest mine in the world. This depth is not reached by a single continuous shaft, so that the Tamarack No. 5, which is 5368 feet long, still retains its laurels as the deepest shaft in the world. The Morro Velho is owned by the St. John del Rey company, in London.

KOREA is to have a new set of mining laws; these are in process of being drafted by the Japanese authorities. One of the requirements will be that each mining company must maintain a head office in Korea, but this will not affect the principal foreign companies, which operate under special concessions. The gold production of Korea in 1914 is given in a recent consular report as $5,000,000; the mines worked by foreign companies showing an increase of $500,000 in their output, and those worked by Japanese and natives a decrease of $300,000. A strong Australian company has purchased placer deposits in South Ham Kyong province and in South Pyeng An province.

PARCELS-POST as a means of shipment of concentrate to smelters is the novel method of transport described in our news columns, two tons daily being shipped in this way by mines in Clearwater county, Idaho. The cost of the service to the Government is greater than the postage charges, so that it may be regarded as a government subsidy to prospecting.

OIL production continues to expand, despite falling prices. This is shown by the Geological Survey's statistics for 1914, just issued. During last year production increased by 17,316,305 barrels, to a total of 290,312,535 bbl., despite a decrease of $23,006,173 in the value of the output. California retains first place for magnitude of production, with Oklahoma a good second.

SHARES of the New Jersey Zinc Company have changed hands at $940 each. Excepting the Calumet & Hecla, this is the highest quotation reached by the stock of a mining corporation in recent years. The high figures are justified, as the company has this year paid cash dividends amounting to 50%, and will soon pay a stock dividend of 250%, the capital of the company having been increased from $10,000,000 to $35,000,000.

FLOTATION in Mexico is appropriate. A revolution in metallurgy finds there a fitting environment of unrest. In the important article that we publish in this issue it is shown how silver ore is readily amenable to the process and how the resulting tailing can be cyanided satisfactorily. The use of alkaline water in the frothing-cell is another notable point. The detailed results, the items of cost, and the careful comparison between cyanidation and flotation will prove deeply suggestive to metallurgical engineers.

OUR attention has been directed to a misinforming paragraph in the *Examiner*, stating that a large acreage of fertile land in Sierra county, California, is to be ruined by dredging for gold. This refers, presumably, to some ground near Redding recently purchased by Mr. Lawrence Gardella, a good citizen and an enterprising operator. The land to be dredged is not fertile

in its present condition, nor is any of the land now being dredged suitable for farming. Moreover, when the ground has been turned over in the course of digging for gold, it is to be leveled and made ready for cultivation. Olive orchards have been planted in the wake of gold dredging. It is poor economics "to destroy fertile lands in order to get a single quick profit," says the *Examiner*. It is poor economics to spread misinformation.

MINES have a double meaning: one peaceful, the other warlike. Hammond is a name formerly associated with gold mines in Africa and elsewhere; now it is to the front in connection with wireless torpedo-control. We congratulate Mr. John Hays Hammond, Jr., on the inventive skill that has won him such honorable prominence.

OUR weekly letter on the metal market will be found interesting despite the dullness of business. A lull in activity has followed an interval of excitement. We look for another rise in prices at an early date. We commend our market report with confidence, for our representative at New York gives the consumers', not the brokers', price. In short, he gives what the mine-operator wants.

MEXICO CITY is again in the hands of the Zapatistas, while the previous army of occupation is somewhere northward preparing to meet Villa's troops, which have occupied Pachuca. That is important, for the Real del Monte, Santa Gertrudis, La Blanca, and other celebrated mines make Pachuca one of the big mining centres of Mexico. Carranza's men have taken Naco, upsetting the arrangement made by General Scott. On the whole, conditions in Mexico indicate with added emphasis that none of the existing factions is competent to restore order. The establishment of a coalition government, backed by Washington, is the only hope for the country.

SILVER-LEAD ore is being mined in the Yukon. Last week we mentioned the fact of a shipment of such ore having arrived here, for treatment at the Selby smelter. In the present issue we publish a short account of the find, as described by Mr. D. Saunders. In the summary report of the Department of Mines, for 1913, it is stated that "Galena creek, a tributary of the McQuesten river, 11 miles off the road to Dutch gulch, was visited as the result of a reported find of a rich argentiferous galena vein. Reports were, to some extent, confirmed by assays of samples sent by the owners to the Territorial Government assay-office at Whitehorse." This refers obviously to the same discovery, which has now become a mine.

PASQUAL OROZCO, recently of Mexico, we find, has at least one good count to his record. Ten years ago the pay-roll money was being taken from Miñaca to the Dolores mine when the escort was attacked by two American outlaws. The Mexican escort was commanded by Bill Smith, with thé aforesaid Orozco as his chief aid. Three Mexicans were killed and six were wounded, but the thieves were repulsed, one of them being captured and killed subsequently at Casas Grandes. After this episode, in which he behaved admirably, Orozco became conductor in place of Smith and he continued to hold the job until the Madero revolution broke out. Then he organized a band of mountaineers and joined the revolutionary forces, becoming a notable leader in the civil war that has brought Mexico to ruin.

ONE of the surprises of the last two years has been the maintenance of handsome profits by the Guggenheim companies—the American Smelting & Refining and the Guggenheim Exploration—despite the chaos in Mexico and the general depression in mining. The wide-spread energies of the American Smelting company are shown by the fact that of the total lead production in the United States last year—564,000 tons—this company refined 317,000 tons, and out of the total domestic output of 1534 million pounds of copper, the same company refined 530 million pounds. By the big production of the Chile Copper Company, and the increasing yield of the Braden, in Chile also, and the Kennecott, in Alaska, the Guggenheim corporation will become a still bigger factor in the copper business.

INCREASE of richness in depth is an idea pleasant to the miner. We read in a San Francisco evening paper that the ore that assayed $4 at the surface of a certain vein in Nevada increased in value to $19.50 at 90 feet. This is a notable increase. If a baby gains 2 pounds in a week, he would gain half a ton in 10 years, at the same rate. So while we congratulate our friend in Nevada on the improved showing at the bottom of his prospect-shaft, we would not call it an "increase in depth," not yet. At the rate of improvement noted, the shaft would strike solid gold at 800 feet. However, almost anything should be possible in the case cited, for *The Bulletin*—the purveyor of valuable information in question—says that "the deep tunnel is in anthracite, which is a gold formation." Not nearly as good as either Guggenheimite or Jacklingite.

Antimony and Arsenic

We have received letters from several subscribers who seem to be under the impression that arsenic has participated in the rise in price that antimony has shown in consequence of demands created by the War. While antimony and arsenic are closely allied in chemistry, their industrial uses differ widely, and, unfortunately for producers, there has been no marked increase in the demand for arsenic. The metal arsenic has almost no industrial uses. A little is used in the making of shot, but as arsenical lead is used for this purpose no market for metallic arsenic is thereby created. White arsenic, or arsenious oxide, is most in request; it is used in the manufacture of glass, in the making of Paris green, London purple, and other insecticides, such as arsenical sheep-dip, for the preserving of hides, and stuffed ani-

mals, and in the making of other arsenic compounds. The di-sulphide and tri-sulphide, corresponding to the minerals realgar and orpiment, are used as paint, and the former is also consumed in the making of fireworks and in the dyeing and printing of cloth. Other salts of arsenic have a variety of limited uses.

All the arsenic produced in this country is a by-product of lead and copper smelting. The origin of arsenical lead is obvious; white arsenic, to the amount of two or three thousand tons yearly, is recovered from flue-dust by the Anaconda Copper Co., the United States Smelting Co., and the American Smelting & Refining Co. Each of these companies could increase its output if the demand justified so doing. The price of arsenic compounds is so low that freight-costs are important and for this reason a larger quantity is imported from Europe than is produced here, since ocean-freights are much less than railway-rates from the Rocky Mountains to the Eastern seaboard. In Eastern Canada arsenical gold ores are found in abundance, but arsenic production does not flourish. In Mexico the Peñoles mining company was a producer of importance, but its output has been hindered by political conditions. On the whole, the production of arsenic is not an alluring business.

Antimony has had a sensational rise in price because of its use in the making of ammunition. Conditions governing antimony production were discussed in our issue of November 14, 1914. Before the War the market for the metal was controlled by English firms, but the embargo on exports from England made readjustment imperative. The Wah Chang Antimony Co., the principal Chinese producer, took advantage of the terms of the contract under which its output was being sold by a subsidiary of one of the English firms and opened its own agency at New York, with the gratifying result that it soon received more orders than it could make immediate delivery. Within a few months the price of the metal rose to six times what it had been. As a result the Chapman Smelting Co., of San Francisco, re-opened its smelting plant and began bidding for antimony ore from Idaho, Alaska, and elsewhere, and operators in Mexico, where antimony ore occurs in abundance, have begun the construction of a plant at San Luis Potosi that will be in operation within three months. Presumably it will serve to lower sharply the present level of prices, as the proposed output will equal 40% of the normal consumption in the United States. The cost of an antimony-smelting plant is not great, and if the War persists for some time the new producers are likely to make large profits. They can hardly hope to develop an important permanent business, for the Chinese producers are able to supply almost all of the normal demand and have demonstrated their ability to work at a profit at the low prices formerly prevailing. According to consular reports, the exports of antimony from Hankow, China, during 1914, were 10,071 tons of crude and 1384 tons of regulus, valued at $486,916 and $88,874 respectively. Ore and secondary products exported during the same period brought the total value of the exports up to $768,935. Production for the first quarter of this year is reported to be at the average of last year for regulus and four times the normal for crude. The great increase in the price has correspondingly increased the value of exports.

Patents and Secrecy

Anonymity seems to characterize recent contributions to the technology of the flotation process. We have published two useful articles under the veil of occasional correspondence, and in this issue we give our readers, under the disguise of special correspondence, a detailed description of flotation work in Mexico. For this concealment of names we have no liking, nor, it is fair to add, have the clever technologists to whom we, and our readers, are indebted for so much timely information. Such secrecy is the sequel to patent litigation; it is due neither to mock modesty nor to any innate love of the mysterious. Whether a decision in an important case now under adjudication will 'lift the lid' and admit fresh air into the fog enveloping technical research into flotation, we do not know. We only hope.

Not that the latest phase of patent litigation over this process is to be debited with all the blame for the general atmosphere of mystery and jealousy that has distorted the technology of the subject during the last ten years. Apart from the embargo imposed upon the publication of information, the protracted series of conflicts over patent rights has served to lessen the scientific value of even the scanty evidence available, for it has created prejudices and interests so strong as to vitiate the judgment or hinder the pen of the few men willing to write on the subject. On the other hand, it may be admitted that the preparation of testimony for lawsuits and the cross-examination incidental to the giving of evidence in open court have served to clarify the basic ideas underlying the process and its application. Yet we are among many that have expressed regret, repeatedly, that the leading protagonists of flotation, such, for example, as Messrs. Frank Elmore and John Ballot, should not have effected a compromise in the early stages of their controversy. Similarly, we think it a pity that the more recent clash of interest between Minerals Separation and its opponents should not have been obviated by reasonable concessions on both sides. In behalf of the profession we express the pious wish that somebody may evolve a scheme for rewarding an inventor without taxing an industry.

It is not the royalty, or tax in money, that does the injury, but the tax on knowledge. Secrecy is a thick-headed watchman that obstructs the alert steps of progress. At the present time the amount of unnecessary work being done is pathetic, for experiments already tried and attempts previously proved futile are being made in many laboratories, simply because there has been no publication of the results heretofore obtained by other investigators. Similarly, useful hints for obviating recurrent difficulties and fertile suggestions for improving practice are withheld because of the scramble for obtaining dubious property rights to ideas by aid

of the Patent Office. As a matter of fact publicity is often an invaluable protector, in so far as it tends to prove priority of invention or application. Our readers are aware, for example, of the Moore *v.* Butters litigation over the vacuum-filter. Not many of them, however, know that the best proof of priority brought forward by Mr. George Moore was the article on his filter that he published in the *Engineering and Mining Journal* of December 5, 1903. That was written at the solicitation of the present writer, who was then editor of our contemporary in New York. The fact of publication was accepted by the Court as an indication that Mr. Moore's competitor must have been cognizant of the details of the device, on the supposition that he had read the published description. Indeed, a lot of unprofitable wrangling over priority of invention could be obviated by a frank publication of details, as in the case cited. We need only add that our columns are always open to the publication of metallurgical information and we shall be glad to serve as a means of giving guidance to the prospectors of technology. Moreover, we hope that the alert and generous spirits in the ranks of metallurgy —and there are, thank Heaven, plenty of them—will use our columns to add to the accelerating progress of this important process of flotation, by exchanging ideas among each other to the gain of all.

Fine-Grinding

The rapidly growing importance of flotation as a metallurgical process has had the remarkable effect of reversing commonly accepted traditions in regard to fine-grinding machinery. In ordinary water-concentration every precaution must be taken to prevent the production of slime during crushing, as metallic mineral in this form was lost. During the last decade reduction in stages, with the prompt removal of the crushed product from the crushing machine, has become highly developed in consequence of the effort to prevent undesired comminution. In flotation the emphasis lies on other criteria. Slime has no terrors for it; in most cases the process seems to work better if a proper proportion of slime is present; while coarse material, even if consisting wholly of valuable mineral, can be floated only with difficulty. The metallurgical need for stage reduction disappears, and the simplest arrangement in milling would be to have a single machine to reduce the ore to the size desired for flotation treatment. Since, for this purpose, all the ore may have to be crushed to pass 80-mesh, so simple an arrangement is scarcely practicable, but at any rate the necessity for a complicated series of rolls and other crushing devices, with their accessories—feeders, elevators, and screens—no longer exists. In the Inspiration flow-sheet, published in our issue of July 3, the reduction of the ore to pass 48-mesh is performed by a Symons disc-crusher and a Marcy ball-mill in one-half of the mill, and by two disc-crushers and Hardinge mills in the other. It must not be assumed hastily that by reducing the number of machines required, the cost of crushing can be equally decreased. It requires the expenditure of power to crush ore, and of two mechanically satisfactory machines, the one that crushes double the quantity of ore must necessarily use about double the power. Fundamental principles in design must, of course, be observed; a heavy hammer is essential for double-hand drilling, but unsatisfactory for driving tacks. It is for this reason doubtful whether any single machine can give the best results in reducing lump ore to fine sand in a single operation. It is common practice to do this with stamps, but it is well known that the stamp is inefficient in its use of power, nor is it practicable to produce by stamps so fine a product as is desired for flotation without cutting down the tonnage to an uneconomic degree. The tendency of late years has been to allow stamps to make a comparatively coarse product and finish the crushing in some other machine. It is not probable, therefore, that single-stage reduction preliminary to flotation will ever prove feasible. Two or three stages are likely to represent the practical minimum.

The question arises, however, whether the investigation of crushing machines may not be profitably directed along wholly new lines. Such machines accomplish their work either by impact, as in the case of stamps, by pressure, as in jaw-crushers and rolls, by trituration, as in a disc-crusher, or by true grinding. Of the latter an arrastra is perhaps the best example, though every grinding-mill also utilizes one or more of the other forms of action. Such machines as tube-, pebble-, and ball-mills do their work by a combination of impact-trituration, and grinding. Theoretically, grinding is the best way in which to obtain a fine product, while trituration is the best method for securing a granular product: the latter cannot be easily applied to very fine material because of excessive friction between the triturating surfaces. Friction between the working surfaces is also important in grinding machines, leading to waste of power and excessive wear. It is obvious that a machine that grinds away material fed into it is likely to grind away itself. It would appear that the principle of the tube- and ball-mills is essentially sound, since the ore particles are ground against each other as well as against the mill.

The factor of time is also of importance in fine-crushing. Heretofore the aim has been to secure a quick discharge of the crushed product in order to prevent sliming. Now that sliming is no longer feared, the desirability of quick discharge disappears and it may indeed prove that a longer retaining of the pulp within the body of the crushing machine permits greater efficiency because it leads to finer grinding. On the other hand, it is obvious that it is not good practice to attempt to crush 6-inch lumps and 60-mesh sand in the same machine, and it is a waste of power to retain material in the machine after it has been crushed fine enough to escape. Much careful study is being devoted to the fine-grinding of ore by both mill-operators and machinery-manufacturers. A free exchange of information will greatly facilitate the attainment of a satisfactory solution. For this our columns are open.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more vaulable than casual compliment.

Big Business

The Editor:

Sir—Referring to the editorial in your issue of July 10, under this title, some of the examples cited as illustrative of the economic advantages to be derived through huge mining operations appear, upon analysis, to be lacking in essentials. For instance, examine the records of the disseminated copper mines somewhat closely—Utah Copper, Ray, and others mentioned in your statement as shining lights in the mining firmament—not with a view to critieism, but as to economic results attained, and the support they lend to the argument you advance.

Turning back to the PRESS of June 7, 1913, to an article written by Mr. Heath Steele, the actual percentages of metal recovery effected at some of the large copper properties are given as follows:

Name of mine.	Year.	Actual recovery.
Utah Copper	1910	55.6
" "	1911	59.9
" "	1912	57.4
Miami	1911	66.7
"	1912	61.0
Ray	1911	50.6
"	1912	51.2
Nevada Consolidated	1910	70.0
" "	1911	69.5
" "	1912	66.0
Chino	1912	55.0

In the article mentioned, Mr. Steele points out that the quarterly mill-recoveries reported by the various companies are misleading, and he gives the reasons for this statement. Possibly extraction may have been improved since Mr. Steele compiled these figures; but during the period covered by his record these examples of efficiency on the part of big business (at least as applied to mining) can hardly be referred to as satisfactory. The records made on these properties for the years given might even be considered by economists an extravagant waste of national resources.

This copper has been taken out and sold, largely to foreigners, at an alleged profit of from two to three cents per pound (*Mining & Engineering World,* May 8, 1915, page 863), and in doing this nearly two pounds of copper have been wasted for every three pounds recovered. It must also be remembered in this connection that copper minerals contained in the tailing run out from mills handling 'disseminated' ore, have been irrevocably lost, for, exposed to atmospheric agencies in their existing fine state of division, sulphates are formed which are carried off in the rains.

Considered purely from an economic standpoint, the country would have been the gainer if this copper had been left in the ground until methods were devised for effecting a reasonably high recovery. In well organized communities—Germany, for instance—in all probability the Government would intervene where exploitation of national assets is undertaken in the crude manner often practised in this country.

Nor can it be conceded that very large operations are profitable to the shareholders upon capitalization represented by stock quotations. Because an enormous quantity of cupriferous material is rushed through mills, and sufficient copper is caught to pay temporary dividends, the actual outcome of such operations will not be known until the books are finally balaneed upon exhaustion of the deposits.

An interesting sidelight upon the relation of large corporations to exploitation of 'disseminated' orebodies was obtained last year when the output was said to have been curtailed 50%. With this greatly diminished yield some of the companies claimed that their costs of production did not differ much from what they had been when the properties were operated at capacity.

The facts enumerated tend to diminish the alleged economic advantages of spectacular mining, and produce a lingering suspicion that something remains to be said in favor of operations upon a lesser scale, conducted with more regard for the balance-sheet and less for the stock-market..

As to the further example you mention in favor of big business in mining, the advantage of having 100 stamps upon a single consolidated property, crushing 5 times as fast as a dozen 40-stamp mills on individual mines, why should a stamp in a 100-stamp mill crush 5 times as fast as one in a 40-stamp mill?

A certain number of stamps can be properly supervised by one battery-tender: the number of such units under one roof does not materially affect the economy with which the mill can be operated, although, of course, expenses in some departments can be reduced somewhat in the larger mill. In looking over records for cheap milling of low-grade ore, striking examples are found among those made by small mills, and it is open to question whether the very large mills have at any time exceeded these records. It is not disputed that such large operatione as the Homestake and Treadwell are brilliant examples of practieal mining and metallurgy; but would

not the same management have achieved equally commendable results had it been in charge of smaller properties?

In any event, the dozen 40-stamp mills mentioned by you distribute more money among the communities in which they are operating than does the single large mill, even if it should crush faster. And the slower-crushing mills do not exhaust the mines as rapidly; all of which tends toward betterment in mining communities, increases subscriptions to the Mining and Scientific Press, and encourages advertisers.

As to the assistance rendered by big business in the development of prospective mines, and we all known that mines must be made from prospects, reference again to the pages of the Press is instructive. In your issue of April 10, 1915, p. 592, it is stated that during the year 1913 there were 639 mining properties submitted for investigation to one of the large mining corporations. Of these, all but 101 were rejected on examination of the data and reports, and then 82 of the 101 failed to stand up under preliminary field-examination. Of the remaining 19, two were taken, and a long-time bond was secured on a third. This record is typical of the operations of other large companies. It means that out of 639 prospects brought to the attention of a giant corporation, 636 were considered unsuited to the requirements of big business, which fact, however, does not necessarily condemn them as prospective mines. Big business calls for big mines, for to advance stock quotations large quantities of metal must be produced. But what is to become of the small deposit? And how are prospects to be developed under the régime of megatheric corporations? There are far more comparatively small ore deposits than large ones, and exploitation of the small ones—those which are not large enough to stock and put on the market—must become a matter of increasing importance as the larger mines are exhausted, and prices of the metals advance in consequence.

One of the principal representatives of big business in mining was recently quoted as saying: "Unfortunately, the mining industry cannot see where in the next ten years any more substantial producing mines are to come from." If this forecast proves to be correct, the necessary metals will have to be supplied at an advanced price from small mines operated by individuals, or small corporations, and such a state of affairs will not be detrimental to the mining industry.

W. L. Austin.

Riverside, July 12.

The Waste of Zinc

The Editor:

Sir—During the last few years we have read a great deal regarding the necessity for conserving the coal and timber resources of the United States. It should be realized by our Government that there is equal need for preventing the unnecessary waste of our metals.

The improved methods of concentrating copper minerals has enabled companies (having sufficient capital to operate on a large scale) to handle very low-grade ore, in some cases averaging less than 1½%, profitably, even with losses as much as 40% of the copper. Heavy losses must be expected, of course, when treating such low-grade ore as is now being mined in Utah, Arizona, and Nevada. The percentage of loss of either lead or copper in the treatment of low-grade ore is necessarily much higher than when treating high-grade ore, for where there is only a few pounds of metal to be extracted, the weight of the remaining waste is much greater, so that even if the waste to be thrown away is as clean in one case as the other, the most waste would carry off the most metals to be divided by the smaller weight of metal in the original ore. This is easily explained, but seldom appreciated by the mine-owner.

The introduction of the bag-house and Cottrell's system of saving the fume and dust, at copper smelters as well as at lead smelters, has reduced the metallurgical loss in that department, but, with all the improvements in copper mining and reduction, how long will the supplies of such ore last? Mr. D. C. Jackling has been quoted as asserting that, at the present rate of production, there are no known sources of supply capable of meeting the world's requirements for the next 20 years.

[This reminds us that James J. Hill once ventured a similar prophecy as to the supply of iron ore.—Editor.]

Mr. Jackling is, I believe, right; but the question of a zinc supply is no less important. The loss of zinc, in its recovery from the original ore, is much higher than the losses of other metals, while no attempt is made to recover the zinc from ores as poor as the copper ores that are being treated successfully. The statement has been made that the average recovery of zinc from ore is 51%. This poor recovery is no doubt partly due to the large amount of low-grade zinc ore mined and concentrated throughout the Mississippi Valley states.

The loss of zinc, when smelting zinc concentrate, is greater than the loss of lead and much higher than the loss of copper in copper smelting. The greatest waste and a double loss to the mine-owner, is not only the loss of the zinc, for which he gets nothing when contained in an ore treated for other metals, but the penalty he has to pay on account of the zinc. This is illustrated in the following example.

The miner sends his ore to a custom smelter; this ore contains, say, 20% zinc. The regular penalty is 50c. per unit above 10% zinc. The value of 85% of this zinc, 340 lb. @ 5c. is $17, which is lost.

Now he pays a penalty on this ore of $5, the usual treatment charge on lead ore of $8, and if a sulphide ore, a roasting charge of $2, making a total penalty and treatment of $15, in addition to the loss of the zinc. With few exceptions, 80 to 85% of the zinc in such ore can be recovered in addition to lead or copper, with gold and silver, for a smaller cost than the combined treatment and penalty now charged where the zinc is wasted.

I am not criticizing the custom smelter for penalizing the zinc in the ore, especially the lead smelter, knowing too well the trouble the zinc causes them, by helping to form incrustations on the walls of the furnace and in the

lead crucible, carrying other metals into the slag and adding to the lead-silver losses by volatilization.

The great waste of zinc throughout the West starts in the mine, where it is left. If broken in order to get out the other ore, it is thrown over the dump as waste or left in the fills to be perhaps forgotten or left until the mine has been abandoned, when it will not pay to re-open the mine to get at it.

Now, as the consumption of zinc is increasing, as its value is more fully appreciated, I would like to know how long our zinc mines will last as compared with the copper mines that can be worked to great depth?

There is no doubt in my mind but that most of this zinc waste can be avoided. Whenever the zinc is recovered from the complex ores of the Western states, the copper, lead, silver, and gold can also be extracted all of which are now almost valueless on account of the presence of the zinc.

Several metallurgical chemists, with whom I am acquainted, have spent time and money in experimenting on these lines with leaching processes for the treatment of complex ores, especially ore not suited to concentration schemes. Several of these processes have passed the experimental stage on small lots of a few pounds each, and the chemists are too poor themselves to erect a plant large enough to prove their statements on a commercial basis. When they present their schemes to individuals or corporations able to develop their ideas for them, the chemist generally asks too much and expects to keep control of the process through secrets or patents. He makes unreasonable demands. On the other hand, corporations are often represented by officials slow to act, even when they may think well of the process presented for their consideration; first, on account of the risk they take of injuring their own reputation in case the process should prove a failure after they have recommended it, and second, some of the officials themselves may have some schemes of their own and consider it their duty to work out a process for their company themselves. With these two conflicting elements, and the men with money naturally afraid of losing it, it is a difficult matter to get any new process developed so as to justify the installation of a plant large enough to treat such ore profitably, and if they did, those who control the process through patents or secret usage are not likely to let the public have the benefit of it. On the other hand, if the Government, through the Mining Bureau, had the process developed, and gave the inventor a reasonable royalty or purchase price, so as to release the process for use under certain conditions, including perhaps some small payment to the Government, then metallurgical advance would be facilitated.

The excellent research work now being carried on by Dorsey A. Lyon and others in the Bureau is not sufficient. It is necessary to select from and commercialize some of the processes suggested by this preliminary work, which should be continued by our Government.

I would suggest that the metallurgy of zinc be the first to be taken up and improved, on account of it being the commercial metal suffering the greatest waste at present, and because the recovery of the zinc from complex ores will save other valuable metals.

S. E. Bretherton.

San Francisco, July 17.

Stamp-Milling in Georgia

The Editor:

Sir—Your 'concentrate' in the issue of July 3, stating that "the first stamp-milling in the United States was done in Georgia," impels me to send you a photograph of a mortar which was in use in a stamp-mill at the Columbia gold mine, in McDuffie county, Georgia, in 1833. This mortar is now in the museum of the Hammond Laboratory, Sheffield Scientific School, Yale University.

MORTAR USED IN STAMP-MILL ON LITTLE RIVER, M'DUFFIE COUNTY, GEORGIA, IN 1833.

Gold was discovered at that place in 1829; and the working of the mine and mill was continued up to 1861, when the mill was dismantled by the Confederate government, which needed the boilers, engine, and iron equipment.

N. S. Keith.

Philadelphia, July 9.

The Talisman mine is one of the most important in New Zealand. During the year ended February 28, 1915, the mill treated 50,190 tons of ore by stamping and cyaniding, yielding 63,192 oz. gold and 116,534 oz. silver, valued at $1,224,000. Costs totaled $10.94 per ton. The operating profit was $777,000. Dividends amounted to $577,000.

Efficiency Engineering in the Copper Country

By P. B. McDONALD

The recent death of Frederick W. Taylor, the originator of efficiency engineering, or scientific management, evoked varying opinions as to whether or not the systems he advocated had succeeded. Not so much is heard of scientific management as was the case four or five years ago, when it first began to be applied to mining. Some mining men still retain their original enthusiasm for the system. Others see good in it, but also see limitations. Still others never cared for its principles. Thus Frank Richards, managing editor of *Compressed Air Magazine* speaks of 'Taylorism' as one of the fads that the American people seems to require to play with, and he quotes an English authority who styled it "a peculiarly hideous system of dehumanization." One of the mining regions where efficiency engineering, or 'Taylorism,' has been given a most thorough trial is the Lake Superior, more particularly in the copper country, where the Calumet & Hecla went into it on an extensive scale, being followed to a lesser degree by the other copper-mining companies, and also by some of the iron-mining companies on the ranges to the south.

By the Calumet & Hecla, as here mentioned, is meant not only the consolidated Calumet & Hecla mine proper, but also the several subsidiaries. It was in the Superior mine, near Houghton, under the superintendent, Ocha Potter, that most of the innovations and short-cut systems were tested before being applied to the larger mines at Calumet. Supt. Potter, a man of considerable experience and a graduate of the Michigan College of Mines, was a strong advocate of scientific management, as were likewise both John Knox, the general superintendent of the Calumet & Hecla, and James MacNaughton, the general manager, who took an active interest in all the different ways and means worked out by Potter and his assistants.

Efficiency in its every phase was gone into most thoroughly and minutely; drilling, blasting, 'mucking,' tramming, timbering, co-ordination of work, mechanical aids, improved rock-drills, care of old stopes, disposal of waste rock, tailing, etc. Observers with pencil, paper, and watches standardized all movements of the miners. New varieties of rock-drills of various weights, styles, and with different pressures of air, were tried and the advantages of each figured out. Suggestions were made to a company manufacturing rock-drills toward co-operation to produce a special drill, based upon information obtained from experiments in the copper mines, that would be exactly suited to the conditions and requirements of the tough amygdaloid rock of the copper country and to the abilities of the miners operating it. By carefully trying new methods at the Superior mine and proving them feasible before adopting them at Calumet, it was possible, when some of the old miners at the latter place said, "It can't be done," to bring Potter and one or two men from Superior and demonstrate that it could be done. Soon a regular staff of efficiency engineers was on hand in all the Calumet & Hecla mines, many of them college men who had been trained for their work by an apprenticeship at the Superior mine. The results attained were extraordinarily gratifying. In a comparatively few months the cost of driving had been reduced 60%; the cost of stoping had been decreased a smaller, but an appreciable, amount; timbering and general co-ordination of work had been materially improved. The new one-man drills proved great time-savers and cut costs immediately.

Driving, in its various phases of drilling a set of holes, blasting, and 'mucking,' offered a favorable opportunity for measuring what each man accomplished, and lent itself to standardization due to the self-contained and comparatively simple nature of the advance of a drift. The most noticeable gains in efficiency were achieved in driving. Stoping, with the difficulty in seeing and recording just what one miner had done and how much rock he had broken, was less amenable to scientific improvement, and it was found that stoping methods could not be accelerated to the extent possible with driving. But the most decided obstruction to the instant success of the plans of the efficiency engineers was the sullen opposition of a great mass of the miners. They did not like the new "pencil methods" of standardization, and particularly objected to working alone on the one-man drills. A few converts were made and won over to the cause of progress, but for the most part a stubborn resentment and general dislike against doing things by rote prevailed in the ranks of the thousands of Cornish, Finnish, Polish, and Austrian miners, who distrusted, mistrusted, and did not understand this comprehensive grafting of a standardized and detailed set of rules on what had hitherto been ordinary everyday mining.

The efficiency plans that the Calumet & Hecla gradually put into practice were so carefully entered into, so thoroughly worked out, and so systematically administered, that estimates of the amount of money they were going to save in operating ran into the hundreds of thousands of dollars per year. The cost of rock-drills, drill-repairing, and incidentals in general had mounted tremendously, but wonderful reductions in the cost per foot of driving and the cost per ton of rock stoped had been gained, as well as considerable savings in the amount of timber used and miscellaneous economies.

Just when scientific management had got into full swing, the disastrous labor troubles came, based, from the miner's standpoint, on antagonism to the one-man drill, to working alone, and to mistreatment by "petty bosses." Whether or not the strike of the copper miners

was a direct result of the efficiency engineering campaign is, of course, a matter of opinion. Possibly it would have come about anyway, regardless of efficiency systems. It is likely that the new methods of working had something to do with making it possible for agitators from the Western Federation of Miners to gain a foothold and a following in Michigan. In the end the copper mining companies won, but they lost a great deal of money from the long bitter struggle and expensive shut-down occasioned by the strike. It is not difficult to see that millions of dollars were lost both by operators and men in the weary months of fighting and bad feeling.

In so far as faster rock-drills and superior facilities for repairing them, better co-ordination of the different phases of underground work, and more accurate knowledge of practical mining, have resulted from efficiency engineering in the copper country, the system has been an undeniable success. As to any lasting or consistent speeding of the miners at their work, judges of the situation are not so sure. Averaging losses and gains in the labor element, an unprejudiced outsider could not be certain that the companies have benefited except in the mechanical line, particularly as regards rock-drills and their maintenance, and in better appreciation—on the part of the staff of officials—of the peculiar problems of underground mining. To get a correct valuation of the advantage or disadvantage of efficiency engineering, a long period of time should be considered, so that the effect on the labor situation could be gauged and weighed.

Other mining companies in the copper country followed the lead of the Calumet & Hecla, and worked out many economies and improvements in the standardization of underground methods. But like the Calumet & Hecla, they also lost heavily in the strike. On the iron ranges to the south and west, a few enthusiasts in scientific management developed, and the American mine at Diorite, the Munro Iron Mining Co. at Iron River, and even one or two of the Oliver mines on the Mesabi, conducted more or less complete experiments in observing, recording, and systematizing underground work. However, the iron operators were too busy with other matters, or were restrained by conservative Eastern managements from doing much more than experiment with the new ideas. Some creditable improvements were effected at several mines, such as better provision for getting dull drill-steel sharpened, timber-saving devices, faster rock-drills, economies in distribution and use of dynamite, etc., but scientific management, where known as such, was not persistent to any marked degree on the iron ranges. The individual iron mines merely continued to do common-sense operating, getting out the ore and shipping it, as cheaply and as handily as possible, while keeping all eyes open for wastes and leaks, as has always been done in the ore business of Lake Superior.

In the main, efficiency engineering in this region has accomplished a number of economies—mostly mechanical; in its effect on labor the advantage is doubtful, and undoubtedly the disastrous labor unrest was partly due to opposition by the miners to the attempt by efficiency enthusiasts at standardizing and speeding mining.

Silver Discovery in the Yukon

By D. SAUNDERS

The discovery claim was staked by H. W. McWhorter upon a creek that he subsequently named appropriately Galena. Galena creek is a tributary of the north fork of the McQuesten river; in fact, this part of the country might be correctly described as the headwaters of the McQuesten. Upon the first tier of benches from the level of the river there is a narrow canyon, about 70 ft. deep, offering all that could be desired in the way of help to the prospector, revealing, as it does, the formation splendidly. About 10 ft. above the level of the creek, between a hanging wall of quartzite and a footwall of mica schist (both walls being remarkably well defined) 4 in. of galena showed in the outcrop in a more or less decomposed condition. This, upon being assayed for silver, gave high returns. An adit was immediately commenced and, upon driving only a few feet, 12 in. of galena and considerable pyrargyrite was uncovered. Stoping operations were started, a trail was cut for 30 miles through gnarled and stunted firs, swamp, muskeg, and mosquitoes to Mayo Landing and as soon as the snow began to melt 59 tons of ore was piled at the landing to await spring and the 'break-up.' After being freighted down the Stewart river, the ore was carried up the Yukon to Whitehorse, over the White Pass by railroad, and down the Pacific coast to Vancouver, where it was again trans-shipped. The ore eventually landed at the smelter at Trail, British Columbia, somewhat travel-stained and worn but still able to fetch the welcome returns of $269 per ton. [Some of it came to the Selby smelter, San Francisco].

A shaft was then sunk upon the vein to a depth of 100 ft. and a cross-cut driven for 60 ft. To the 100-ft. level the vein maintains a fairly uniform width of 24 in. from wall to wall, dipping at an angle of 35°, the general strike being north-east.

At this depth a rich ore-shoot about 30 feet wide was followed down for another 60 ft., the orebody rapidly becoming wider and the dip a little steeper, the galena averaging 40 in. in width, with 12 in. of vein-filling carrying pyrargyrite in abundance. Argentite and stephanite in less proportions are also observed. Already 1380 tons of ore has been extracted (by single-jack work), sacked, and shipped to the smelter.

Development work is rapidly proceeding in an endeavor to get enough ore in reserve to warrant the erection of a reduction plant, the ore being amenable to concentration either by oil-flotation or water. The cost of development in a new camp is always high, but the cost of transportation from a remote place like the watershed of the McQuesten to the nearest lead smelter can only be described as terrific.

Some systematic and thoughtful prospecting along the strike of the vein has been done on both sides of the discovery claim but up to the time of writing nothing worthy of note outside of the one rich small shoot—about 30 ft. wide—now being worked, has been disclosed.

Flotation in a Mexican Mill

By A SPECIAL CORRESPONDENT

Present Concentrating Methods. The mill receives 200 tons per day of crude mine ore. After being crushed to 2-inch size, this ore is passed over a picking-belt, where one ton of high-grade ore and four tons of waste are removed each day. The remaining 195 tons of second-class ore is crushed in stamp-batteries, to pass a 4-mesh screen. Lime-water, in the proportion of 7 of water to 1 of ore, is added in the battery. The pulp from these is classified roughly, the coarse sand being ground in a Hardinge mill to pass a 20-mesh screen. The pulp is again classified roughly into four sizes of sand and one size of slime. The sand is concentrated on Wilfley tables and the slime (after being settled to 7:1 in cone-bottom tanks) is concentrated on Deister tables.

The slime-tailing, from the Deister tables, is re-concentrated on vanners. The tailing from the vanners settles to 3½ tons of water per ton of slime; the water being further reduced to ¾:1 in a vacuum-filter. The filter-cake is washed with weak barren solution before being sent to the cyanide plant.

The sand-tailing from the Wilfley tables of the stamp-mill is classified carefully in mechanical classifiers; the slime under-size joins the slime-tailing from the re-concentrating vanners, and the sand (after the addition of cyanide solution) enters the tube-mill circuit, where it is joined by 50 tons per day of dump-tailing. All tube-milling is done in cyanide solution. After passing through the tube-mills, the combined current and dump sands are re-concentrated on Wilfley tables. The tailing from these tables is classified, the coarse sand re-entering the tube-mill circuit and the slimed sand being thickened in three 24-ft. Dorr vats before entering the cyanide plant.

Metallurgical Results of Present Methods

	Gold, oz.	Silver, oz.	Copper, %	Lead, %
The feed to the stamp-mill assays	0.1	35.4	0.25	0.7
The concentrate assays	2.0	570.0	2.0	10.0
The tailing, after concentration, assays	0.03	18.0	0.15	0.4

The recovery therefore is: gold, 65; silver, 48; copper, 35; and lead, 45%.

Necessity of Better Concentration. The above data show that a little more than half the gold is being recovered in concentration, and that the recovery on silver, lead, and copper is less than half the contents in the original ore.

Tests indicate that more than 90% of the metal in the original ore occurs in the form of sulphides. Hence half of the metallic sulphides of the original ore enters the cyanide plant. This is undesirable for the following reasons:

1. The extraction of silver from sulphide metals is poor in the cyanide plant; the concentrate produced from panning current residue assays between 50 and 100 oz. silver per ton, and the tailing from panning invariably assays below 2 oz., even when the residue assays as high as 5 oz.; showing that the poor extraction is due to undissolved silver in the sulphides.

2. The presence of metallic sulphides increases the cyanide consumption. The chemical consumption of cyanide is reduced from 4 to 1 lb. per ton when the metallic sulphides are removed from the heading to the cyanide plant. The present excessive cyanide consumption is due almost entirely to the solution of copper from the ore.

3. The presence of copper and zinc sulphides in the cyanide pulp fouls the solution, thus decreasing the extraction from the rest of the ore.

The possibility of improving results by better concentration of the ore has long been recognized. For this reason, arrangements were made for re-concentrating. Both arrangements have effected a reduction of assay-value in the final residue and a corresponding increase of profit.

Methods for Improving Present Concentration. Lately, extensive tests have been made to determine the possibility of still closer concentration. Careful panning reduces the average feed to the cyanide plant from 18 oz. silver to 10 oz. per ton.

Canvas tables give slightly poorer results. A full-sized canvas table, treating tailing from the Deister tables (assaying 20 oz. per ton) produced 15 oz. tailing—an extraction of 25%. Further tests along this line were discontinued on account of securing much better results from laboratory flotation tests.

Laboratory Flotation Tests. All flotation tests, made in the laboratory, were run in separatory funnels. The general procedure in the tests was to mix 100 grams of *minus* 200-mesh ore with water in proportion of four of water to one of ore. Suitable amounts of oil were then added and the mixture shaken violently. After allowing the pulp to settle for a few moments, the bottom cock of the funnel was opened and the tailing run into a second separatory funnel for another flotation treatment; the cock being closed before the froth began to run out. This process was repeated, on the tailing, from five to seven times. Several hundred tests have been run, all possible variations of conditions being tried. The results of the tests led to the following conclusions:

1. All ores from the mine may be treated by flotation. Semi-oxidized ore from one level yields a tailing assaying 10 oz. silver per ton, while the oxidized ore from another level gives a tailing containing only 2 oz. per ton. The tailing from average ore, when conditions for flotation are right, is 4.5 oz. silver per ton.

2. The grade of tailing appears to be independent of

whether the original ore is treated by flotation, or whether wet concentration precedes flotation.

3. The alkalinity during flotation must be between 0.01 and 0.05 lb. per ton of solution. The best results are secured when the alkalinity is 0.025 lb. When the alkalinity is too low, the extraction is poor although the concentrate is clean. When the alkalinity is too high, both the extraction and grade of concentrate are poor. When the alkalinity is right (0.025 lb.) both the extraction and grade of concentrate are best. The maintenance of proper alkalinity will require the most care of anything in the plant; although it will not be more difficult than the maintenance of proper cyanide strength in the cyanide plant.

4. The dilution may range between $3\frac{1}{2}:1$ and $7:1$; with the best results, on average ore, between $4:1$ and $6:1$. When the pulp is sandy a low dilution is best: pure sand, ground to 200-mesh, requires a dilution of $1:1$. Average slime, like the Deister feed, on the other hand, requires a dilution of $8:1$. Good extraction may be secured on either sand or slime, provided approximately the proper dilutions are secured in each case. Proper dilutions will be easy to maintain in the plant, for the range for the best work is comparatively large; and when either an excess of sand or an excess of slime occurs in the ore, the proper dilution will automatically adjust itself; for the sand of itself will settle to a thick pulp, while the slime will not settle well, but will remain thin.

5. The temperature is not a matter of vital interest. The extraction is slightly better and the grade of concentrate considerably higher when the temperature is over 100° F., but good results have been secured with the temperature as low as 40° F. It will not be necessary to arrange for heating the pulp, especially at the start.

6. Fine grinding is necessary for good results in flotation. When the mill-heading was crushed to 60-mesh, the tailing from flotation assayed 0.08 oz. gold, and 11 oz. silver; when the same ore was crushed to 100-mesh, the tailing assayed 0.04 oz. gold and 5 oz. silver; and when the crushing was carried to 200-mesh, the tailing assayed 0.02 oz. gold and 3.75 oz. silver.

[The question of the kind of crushing mechanism best adapted to preparing ore for flotation is vital; at present the tube-mill, ball-mill, and disc-crusher hold the field.—Editor.]

MEXICAN MEANS OF TRANSPORT.

7. The best flotation agents, so far tested, are pine-oils. Low-grade pine-oil gave as good results as the higher-grade varieties. S. S. pine-oil, of the General Naval Stores Co. (cost 26c. per gal., f.o.b. factory) has given exceptionally good results. For the best work in flotation it is necessary to have this oil present to the extent of 0.6 lb. per ton of ore. In actual plant-practice, where the water is returned again and again to the top of the mill, the consumption of oil will probably be about $\frac{1}{4}$ lb. per ton of ore. This oil will cost, delivered, 8c. per pound.

Pine-tar oil is much cheaper. It gives good extraction, but the grade of concentrate is low. Cresylic acid, when used with pine-oils, increases the extraction about $\frac{1}{4}$ oz. silver per ton. This hardly pays for its use.

8. In the laboratory tests the grade of concentrate was

low, averaging 200 oz. silver per ton. This concentrate could be raised to 1100 oz. by re-treating the concentrate by flotation.

9. Cyanide tests, run on tailing from the flotation tests, produced residues assaying less than 1 oz. silver per ton, with a cyanide consumption of less than 1 lb. per ton.

10. The dump-tailing cannot be easily treated by flotation. When the methods of flotation that are applicable to mine ore are applied to the dump-tailing, the results are *nil*. Furthermore, when the water that has been in contact with the dump-tailing is used for diluting mine-ore, the mine-ore cannot be treated advantageously by flotation. Experiments show that both these effects are due to the presenee of soluble sulphates (chiefly those of magnesium and calcium) in the dump-tailing. The injurious effect of magnesium sulphate can be overcome largely by an excess of oil. No method of overcoming the injurious effects of calcium sulphate has yet been discovered in the tests.

When the dump-tailing is washed in fresh water half a dozen times, before being treated by flotation, the results of flotation are as satisfactory as is the case with mine-ore. However, a plant for washing the dump-tailing would be more expensive than the small tonnage of this material warrants, and the operation of such a plant would neeessitate the waste of more water than is available. Some other method of rendering the dump-tailing susceptible to flotation may be devised; but the small tonnage does not warrant any extended investigation. The best thing to do, especially at the start, is to send the dump-tailing direct to the cyanide plant (after concentrating the ground sand on Wilfleys) as at present.

11. As a result of the laboratory experiment, it was decided that full-sized tests should be conducted in the plant on run-of-mine ore.

Plant Tests. For this purpose, there were set aside for the flotation circuit, one battery of five stamps, two Wilfley tables, one classifier, one tube-mill, one 24-ft. settler, and one pump for returning the water from the settling-tank to the head of the mill.

A flotation-cell of the pneumatic type was first tried. When treating 20-oz. heading this machine produced a 290-oz. concentrate and a 15.3-oz. tailing. This was far from satisfactory.

Another machine consisted of a series of mechanical-agitation chambers, alternating with a series of settling-chambers. From the start, this machine has given excellent results. In spite of many mechanical difficulties, and trouble with inexperieneed operators, the tailing from the plant has averaged but little above 5 oz. silver per ton, and the concentrate has averaged above 600 oz., without re-concentration.

The chief weaknesses of mechanical agitation, as ascertained in this mill, are:

1. The complex system of shafts and counter-shaft, with the corresponding drives, bearings, etc.

2. The difficulty of adjustment; any slight change in feed necessitating a change in the valves of each chamber.

3. The difficulty of the passages between chambers becoming clogged.

Submerged Agitation. It has been attempted to evolve a flotation machine to overcome these weaknesses, and at the same time give results as good as the mechanical agitation plant. A small machine (capacity 3 tons per day) has been constructed, and this, after many alterations, has yielded a 3.7-oz. tailing and a 680-oz. concentrate, when treating 10-oz. feed. This machine employs a somewhat unique principle of flotation—that of submerged agitation—the mixture of pulp, oil, and air being violently agitated in a partly closed chamber, under the hydrostatic pressure of several feet of pulp in the settling-chambers above.

In construction, this machine is simpler than the machine using mechanical agitation. It consists essentially of a V-shaped box or trough, divided into compartments by a series of vertical partitions. At the bottom of each partition is an agitation-chamber. Agitation is supplied by a paddle-wheel in each chamber. All the paddle-wheels are mounted upon a single horizontal shafting, which passes the entire length of the trough, leaving the end partitions through stuffing-boxes. The pulp enters each agitation-chamber through an opening around the shafting, and leaves the agitation-chamber through an adjustable aperture, at a slight distance from the shafting. The agitator thus acts slightly as a centrifugal pump, overcoming the friction loss in the passage from one compartment to another, and keeping the height of the pulp the same in all the settling-chambers. The adjustment of the aperture is arranged to increase or decrease the centrifugal force. This adjustment occasions much less difficulty than is experienced in mechanical agitation, where the flow from one compartment to another is merely throttled.

Also, in the new plant there are no pipes to become clogged, the passage of pulp from one cell to another being along a rapidly revolving shafting, which keeps all material in suspension. The concentrate overflows from both edges of the trough, thus being removed more promptly than in a plant using mechanical agitation.

Further tests with the small machine are being made, and a larger machine (eapacity 40 tons per day) is being constructed, for thoroughly testing the principles involved. The 40-ton machine will be constructed with the idea of using it for re-concentration of the concentrate, should a full-sized flotation plant be installed.

Simple Mechanical Agitation. The machine has now been operating intermittently for a month. During that month it ran six days continuously, treating 25 tons of 29-oz. pulp and producing 6.4-oz tailing and 600-oz. concentrate. During the first five days of the following month, careful tests were run to compare flotation results with those from current concentrating praetice. The following tables give the summary of results from these tests.

Mill-Tests. Flotation *v.* Present Concentration Practice. Flotation plant takes 25 tons per day of mill heading after being crushed to 20-mesh by stamps, concentrated on Wilfleys, and passed through a tube-mill.

METALLURGICAL RESULTS, PER TON OF ORIGINAL ORE, USING FLOTATION

	Tons.	Assay — Gold.	Assay — Silver.	Contents — Gold.	Contents — Silver.
Mill-heading	1.0000	0.125	39.81	0.125	29.81
Wilfley concentrate	0.0313	3.070	663.27	0.096	20.76
Wilfley tailing	0.9684	0.030	19.70	0.029	19.05
Flotation concentrate	0.0207	1.190	692.78	0.025	14.34

LIQUIDATIONS, PER TON OF ORIGINAL ORE

Concentrate, tons	0.04085
Gold, 0.0777 oz. at $20	$1.55
Silver, 20.24 oz.; 95% at 50c	9.61
Copper, 2.41% − 0.3 = 2.11%; 1.73 lb. at 8.2c	0.14
Lead, 9.7% − 1.5 = 8.2%; 90% at 3c	0.18
	$11.48

PRODUCTS PER TON OF ORIGINAL ORE

	Tons.	Assay. Gold.	Silver.	Copper.	Lead.	Zinc.	Insoluble.
Wilfley concentrate	0.0313	3.07	663.27	2.75	12.00	12.7	24.5
Flotation concentrate	0.0207	1.19	692.78	3.36	11.55	13.9	34.3
Average concentrate	0.0520	2.327	675.00	3.00	11.80	13.2	28.4
Bullion	0.003	3.76	...	....	...	...	

Flotation tailing	0.9477	0.004	4.98	0.004	4.71
Cyanide residues	....	0.001	1.00	0.001	0.95
Cyanide bullion	....	....	....	0.003	3.76

LIQUIDATIONS*

Wilfley and flotation concentrate, tons	0.52	
Gold, 0.121 oz. at $20	$2.42	
Silver, 35.10 oz., 95% = 33.345 oz. at 50c	16.67	
Copper, 3% − 0.3 = 2.7%; 2.81 lb. at 8.2c	0.23	
Lead, 11.8% − 1.5 = 10.3%; 90% at 3c	0.29	
	$19.61	
Less haulage, freight, and treatment at $19.67 per ton	$1.02	
Less taxes, commissions, etc., 7.44%	1.45	2.47
Bankable funds from concentrate per ton of ore.		$17.14
Bullion from flotation-tailing, per ton of ore, 5.56 oz. gross:		
Gold, 0.003 oz. at $20.67	$0.06	
Silver, 3.76 oz. at 50c	1.88	
	$1.94	
Less haulage, treatment, 1.08c. per oz.	$0.06	
Less express, duties, etc., 7.8%	0.15	0.21
Bankable funds from bullion per ton of ore		$1.73

PRESENT PRACTICE. During the five days the flotation test was being run, the rest of the mill received 160 tons per day of the same grade of mill-heading. This was concentrated upon Wilfley and Deister tables and the tailing re-concentrated on Wilfleys and vanners.

METALLURGICAL RESULTS, PER TON OF ORIGINAL ORE

	Tons.	Assay — Gold.	Assay — Silver.	Contents — Gold.	Contents — Silver.
Mill-heading	1.00000	0.125	39.81	0.1250	39.81
Stamp-mill concentrate	0.03650	1.930	518.00	0.0706	18.94
Wilfley re-concentrate	0.00375	1.760	286.44	0.0066	1.08
Vanner re-concentrate	0.00060	0.780	370.92	0.0005	0.22
Tailing	0.95815	0.050	20.40	0.0473	19.57
Residue	0.95815	0.0048	3.12	0.0046	2.98
Bullion	.....	.....	....	0.0427	16.59

PRODUCTS PER TON OF ORIGINAL ORE

	Tons.	Assay. Gold.	Silver.	Copper.	Lead.	Zinc.	Insoluble.
Stamp-mill concentrate	0.03650	1.93	518.00	2.56	10.40	12.9	24.50
Wilfley re-concentrate	0.00375	1.76	286.44	1.03	3.37	6.0	45.28
Vanner re-concentrate	0.00060	0.78	370.92	1.00	5.86	4.7	56.22
Total concentrates	0.04985	1.90	496.00	2.41	9.7	12.15	27.90

Bullion, 24.88 oz. gross; gold, 0.0427 oz.; silver, 16.59 oz. per ton.

*Throughout this article values are given in U. S. Currency.

Less haulage, freight, and treatment, at $19.67 per ton	$0.80	
Less taxes, commission, and expense, 7.44%	0.86	1.66
Bankable funds per ton of ore		$9.82
Bullion from current tailing, 24.88 oz. gross:		
Gold, 0.0427 oz. at $20.67	$0.88	
Silver, 16.59 oz. at 50c	8.29	
	$9.17	
Less haulage and treatment, at 1.08c. per oz.	$0.26	
Less express, taxes, etc., 7.8%	0.72	0.98
Bankable funds per ton of ore		$8.19

COSTS. Labor and repair costs will remain about the same as now. Two high-class operators in the present re-treatment plant will be replaced by three cheap operators in the flotation plant.

Power consumption will be increased about 40 hp. This will cost 5c. per ton.

Oil consumption will be about $\frac{1}{4}$ lb. per ton of ore. $\frac{1}{4}$ lb. @ 8c. = 2c. per ton.

The total increase in the cost of concentration will therefore be about 7c. per ton.

The present cyanide consumption per ton of ore is 6 lb., of which 2 lb. is mechanically lost. Small laboratory tests show that the chemical consumption of cyanide when flotation-tailing is treated, is only 1 lb. per ton of ore. This is 3 lb. less than the consumption when current tailing is treated. If this result is sustained in actual plant-practice, the saving in cyanide alone will amount to 3 × 19c. = 57c. per ton of ore.

The present cost of precipitation and melting is 2.56c. per fine ounce.

In present practice 16.6 fine ounces are produced per ton of ore. When flotation tailing is treated, only 3.7 oz. are produced per ton of ore. This means an excess of 12.9 oz. produced in present practice: 129 × 2.56c. = 33c. per ton of ore.

Probably this amount would be reduced to 28c. on

account of certain fixed labor and pumping charges, which will not be materially reduced if the flotation plant is installed.

FINANCIAL STATEMENT

Flotation *v.* Present Practice, per ton of original ore.

	Present practice.	Flotation.
Bankable funds; marketing concentrate....	$9.82	$17.14
Bankable funds; marketing bullion	8.19	1.73
Increased cost of concentration.....	0.07	....
Decreased cost of cyanide.....	...	0.57
Decreased cost of melting and precipitation.	...	0.28
	$18.08	$19.72

Increased profit per ton from flotation, 200 tons per day at $1.64 = $328 increased profit per day or $9840 increased profit per month.

The above is calculated on the basis of results from a single mill-test of 5 days' duration. During this interval the heading to the mill and the residues were excessively high; indicating a greater advantage in favor of the flotation plant than is actually warranted.

The estimate of probable profit may be revised roughly by using the metallurgical results of the past two months for the basis of calculations. During two months the heading to the cyanide plant has averaged 17.8 oz. silver, and the residue has averaged 2.75 oz. per ton. The residue from cyanide-flotation tailing would assay 1 oz. per ton. This indicates an increased extraction of 1.75 oz. silver per ton of ore. 1.75 oz. at 41c. = 72c. increased profit per ton.

The indicated decrease in cyanide consumption (as determined solely in the laboratory) is 3 lb. per ton of ore. Reducing this to 2½ lb., to be on the safe side, the decreased cost of cyanide would be 2½ × 19c. = 47c. per ton of ore.

The decreased cost of precipitation and melting may be figured as follows: Cost of precipitation and melting, per fine ounce, has been 2.4c. The decreased production of bullion, due to flotation, would be 11 oz. per ton of ore. 11 oz. at 2.4c. = 26.4c. When fixed charges are considered, this should be reduced to 20c. per ton.

When the profit from marketing an increased amount of lead and copper is balanced against the increased loss occasioned by marketing the silver and gold as concentrate instead of bullion, there is a deficit of 17c. per ton of ore.

The matter may be summarized as follows:

	Per ton.
Increased extraction	$0.72
Decreased cyanide consumption	0.47
Decreased cost of precipitation and melting.....	0.20
	$1.39
Increased cost of marketing	0.17
Profits per ton of ore	$1.22

The average tonnage of mine-ore for the past two months has been 5761 tons. Hence the indicated increase in monthly profit would be 5761 × $1.22 = $7028.42.

INSTALLATION OF FLOTATION PLANT. Should a flotation plant be installed, operations in the stamp-mill will continue as at present; though it may be deemed advisable, after the flotation plant is running smoothly, to eliminate concentration in the stamp-mill, and depend upon the flotation plant for all concentration.

Re-concentration of current tailing on vanners and Wilfleys will be discontinued from the start.

The dump-tailing will be treated as at present, with the exception that this material will enter the plant only in the day-time. One tube-mill, one classifier, one elevator, and the re-concentrating Wilfley tables will be kept separate from this circuit, which will be in cyanide solution. All lime for the cyanide plant will enter this circuit. One of the 24-ft. tanks and one of the pumps must be reserved for the dump-tailing circuit.

All the tube-milling of current sand tailing will be done in mill-water, instead of cyanide solution.

The ground sand, together with the current slime, will be settled in two of the 24-ft. thickening-tanks, and will then enter the flotation plant. From the flotation plant, the tailing will flow to the two 33-ft. thickening-tanks. The thickened pulp from these tanks will be de-watered and washed in the vacuum-filter before entering the cyanide plant.

All lime for the mill-circuit will be added as an emulsion to the flotation-tailing launder, where it will be under direct control of the flotation-operator. The water in the 23-ft. thickening-tanks will contain about 0.4 lb. dissolved lime per ton. This is ample for good settling. The overflow from these tanks will be reduced, by consumption, to about 0.1 lb. per ton. This is sufficient for fair settling in the cone-bottom tanks of the stamp-mill. By the time the pulp reaches the 24-ft. thickening-tanks the lime will be reduced to 0.03 lb. per ton. This low lime will be extremely detrimental to good settling in these tanks.

INSTALLATION REQUIRED. The matter of supplying proper settling and de-watering facilities will be the most serious and most expensive part of the installation.

The two 24-ft. thickening-tanks, to be used in the flotation-circuit, must be triple-decked. It will also probably be found necessary to double-deck the 32-ft. steel thickening-tank. The work on settling-tanks will cost about $6000.

By increasing the settling capacity, the pulp will probably be settled to a sufficient thickness that the vacuum-filter will be able to handle the combined sand-slime feed.

It may be found necessary, however, to add another unit to this plant. This will cost $2000.

The flotation plant will consist of two units (each of which will be able to treat the total tonnage of current tailing) and one smaller clean-up machine. The whole plant will cost about $3000. A filter-press for handling the concentrate will cost $2000. Tanks, air-lifts, launders, and buildings will cost $2000. Thus the whole installation will cost $15,000, or $20,000 at the most. The addition of the flotation plant, for treating current tailing, will increase the profit about $7000 per month. Practically all ore from the mine may be treated by flotation.

PLAZA OF POTOSI.

THE MOUNTAIN OF POTOSI.

The Potosi Tin-Mining District, Bolivia

By FRANCIS CHURCH LINCOLN*

History. The Potosi tin-mining district is near the city of Potosi in the south-central part of Bolivia, South America. Besides the mines in the immediate vicinity of the city, it may be considered to include the Huari-Huari mines 15 miles northeast and the Porco mines 30 miles southwest. The Potosi mines are much older than those of the Milluni and Quimsa Cruz districts, both of which have been described in previous articles†, those at Porco having been discovered long before Columbus landed in America, while the Bolivian Indians were still under the rule of the Incas.

Maita Capajh, fourth of the Incas, whose reign began in 1171, extended the boundaries of the Inca empire from Cuzco, now in Peru, as far as what is at present the city of La Paz in Bolivia. During this extension, the rich silver mines of Porco were discovered and were afterward worked by Maita Capajh and his successors upon a large scale. The name Potosi is said to have originated with a later Inca, Huaina Capajh, who camped near the beautiful peak in 1462. So impressed was he with the grandeur of the mountain, that he thought it must contain silver and sent some of his retainers there to prospect for the precious metal. The prospecting party was overtaken by one of the violent thunderstorms prevalent in that region, and becoming frightened by a terrific peal of thunder, ran back to the Inca with cries of "*Potojsi*!", which is the Quichua Indian for "It made a loud noise!" The prospectors also declared that in the calm succeeding the report they had heard a voice saying, "Touch not the silver of this mountain, it is for other owners!" Some doubt is cast upon the veracity of this ingenuous tale by the existence of another Quichua word, *potojchi*, which means 'fountain of silver,' and whose applicability is apparent without the aid of a picturesque story.

The silver in Potosi mountain was discovered at the beginning of the Spanish colonial period. According to the historian, Marco Jimenez de la Espada, four Spaniards who were seeking argentiferous galena in the neighborhood in 1544, sent an Indian named Gualpa with a companion to the summit of the peak to collect any valuable offerings that might have been made in the huaca, or sacred spot, situated there. Nothing of great value was found, but Gualpa loaded his companion with part of the offerings remaining to gather the rest himself. A violent windstorm then descended from the top of the mountain, knocking Gualpa insensible. When he recovered and started to rise, he found in his hand a rich lump of silver ore. Another historian says the discovery was made by an Indian chasing a stray sheep, and there are several other yarns in circulation as to how the famous mines were discovered, but whatever may be the true one, it is at least certain that in 1545 the city of La Plata, later known as the Villa Rica Imperial de Potosi, was founded by 75 Spaniards and the exploitation of the mines was begun. Reports as to the annual and total productions of the silver peak of Potosi vary greatly, but according to Wendt‡, who has made a careful study of the subject, there is little doubt that the aggregate product has exceeded 1,000,000,000 ounces. Potosi has therefore been the largest silver producer in the world.

The Huari-Huari silver mines were also discovered by the Spaniards, who operated them upon a comparatively small scale. Huari-huari means "many vicuñas," the vicuña being a wild Andean animal closely related to the domestic llama.

All the mines of the Potosi district therefore have been

*Director Mackay School of Mines, Reno, Nevada.

†Mining and Scientific Press, March 27 and May 8, 1915.

‡Trans. A. I. M. E. Vol. XIX, p. 74, (1891).

worked for silver in the early days. Within recent years, however, these mines have become important tin producers, while their production of silver has become almost negligible.

Geography. Potosi is situated on a branch of the Antofagasta & Bolivia Railway, which leaves the main line at Rio Mulato, 106 miles distant, and crosses a pass 15,770 ft. in elevation, to reach the city, which is itself at an elevation of 3560 ft. above sea-level. The population is about 35,000. The peak on which the mines are situated rises to a height of 2000 ft. above the city, forming a nearly perfect cone, and as the surface of the hill is almost completely covered by multicolored mine-dumps, it presents a strikingly beautiful appearance.

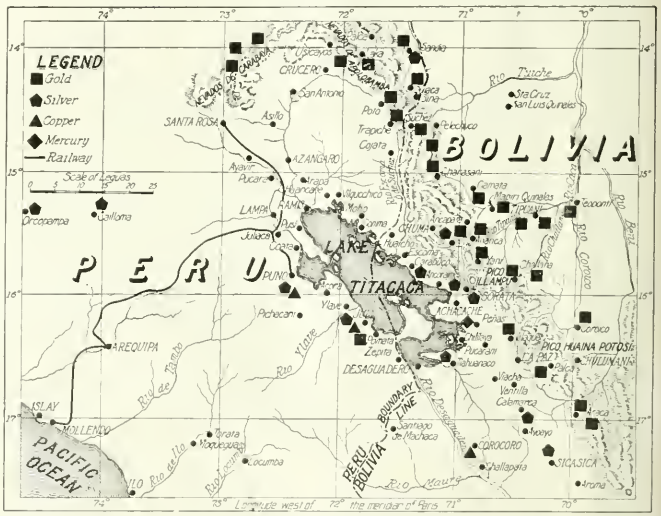
Porco is 2 miles from the railroad at Agua Castilla, and about 30 miles from Potosi. The mines are in the hills near the town and are connected with the mill, which is near the station of Agua Castilla, by an aerial tramway. The town is a small one, inhabited only by Quichua Indians.

The town of Huari-Huari is also a small one, only inhabited by Indians. It is 18 miles from the terminus of the railway at Potosi, and at an elevation of 13,100 ft. From Potosi, the road to Sucre (the nominal capital of Bolivia) is followed for 12 miles to the baths of Don Diego, whence a branch road 6 miles long runs to Huari-Huari. The mines are situated in the hills above the town.

Geology. Potosi peak is formed of rhyolite intrusive through Jurassic shale and sandstone, as well as Tertiary sandstone. The veins form a linked system that cuts all the country-rock indiscriminately. Tin and silver occur together in these veins. The tin is usually in the form of light-colored cassiterite (tin oxide), rarely in that of stannite (sulphide of tin, copper, and iron). The silver mined from near the surface was mainly in the form of chloride and native silver, but in depth most of it is contained in argentiferous tetrahedrite. Quartz and iron oxides are the principal gangue-minerals of the oxidized ore, while pyrite, a little chalcopyrite, and occasionally sphalerite and galena occur in depth.

At Porco, the geological conditions are similar to those at Potosi, save that no Tertiary sediments have as yet been discovered and that silver frequently occurs as ruby silver (proustite). At Huari-Huari, however, the ore deposits are of a somewhat different character. The town occupies a valley with Mesozoic sediments on one side and Paleozoic sediments on the other. Tin-silver veins occur in the Mesozoic shale, no igneous rock having been cut in the mines. The tin is in the form of cassiterite, while the silver occurs as pyrargyrite and as argentiferous jamesonite, with galena. Pyrite, hematite, and sphalerite also occur in the veins.

Mining. The mines of the peak feel the ill effects of mining regulations dating from early Spanish times that are not in effect in the newer tin-mining districts of Bolivia. According to these old laws, mining property is not held by surface claims as under the new laws, but by *boca minas*, or mine-openings, each of which pays a tax of 4 bolivianos (about $1.60) per year. There are some 5000 mine-openings, mostly in the form of adits in the mountain. These workings may be continued indefinitely as long as they do not run into those starting from other mine openings. As far as surface boundaries are concerned, it is evident that the mine-opening claims may overlap one another, and that the quantity of ground controlled by one mine opening is dependent not only upon its position, but also upon the activities in neighboring mine-openings. It will be seen readily that the opportunities for litigation far exceed those made possible by our own apex law; our own system is not, therefore, the worst in the world as some of those who have experienced its drawbacks are inclined to believe.



MAP SHOWING POSITION OF POTOSI.

The miners at Potosi receive from 2 to 5 bolivianos per day, (from $0.80 to $2), while at Huari-Huari the scale of wages is lower, being from 1 to 2 bolivianos (40 to 80 cents). Mining is conducted in a most casual and desultory fashion, the principal operators in Potosi being the French firms of Louis Soux and Bebin Frères. Regular mining operations have recently been begun at Porco by the Porco Tin Mines, Ltd., a subsidiary company of the powerful firm of Aramayo, Francke Mines, Ltd., which is operating many tin, copper, and bismuth mines in Bolivia.

Milling. A list of the principal mills operating in the Potosi district in 1914 is given herewith, together with their approximate monthly productions of 60% tin concentrate.

TOWN OF PORCO.

QUICHUA INDIANS.

Mill and owner.	Concentrate, Tons.
Velarde, Louis Soux	140
Huayra, Bebin Frères	80
Socavon Royal, Anglo-Bolivian Mining Syndicate	40
Cucho, Arturo Casada	30
Colavi, Alfredo Metting	20
Huari-Huari, Cia. Minera y Agricola Huari-Huari de Potosí, A. Delgado, manager	20
Re-working tailing, Matias Mendieta	27.5
Re-working tailing, Mendoza y Cia	15

None of these are modern mills, and their operations are in every instance both crude and inefficient. Jigs, Wilfley tables, and convex or concave buddles make up the usual equipment. A general impression seems to be prevalent that the Wilfley table should discharge all its products over the head end, and to insure this some of the mills even go so far as to attach boards to the sides of the Wilfleys to prevent their discharging in the ordinary manner! It is therefore not surprising to learn that in one mill the Wilfley tailing is re-treated no less than 8 times to get the content down to 1% tin!

A brief description of the milling process as conducted in the largest mill may prove of interest. The ores are obtained from various mines and dumps; they range from rich ores containing 15% tin and 8 marcos per cajon of silver (about 24 ounces per ton), to poor dumps containing only 1% tin. The silver-bearing ore is first treated by the hyposulphite lixiviation process to remove the silver, and concentrated afterward for the tin. Water-power is used, supplemented in the dry season by power obtained from a 70-hp. oil-engine burning Peruvian oil, which costs about 35 cents per gallon delivered at the mill. The tin-silver ores are roasted in small hand-rabbled reverberatory furnaces, first raw and then with salt. The fuels employed are *yareta*, a resinous plant, and *taquia*, llama dung, the cost being about $8 and $5 per ton, respectively. After being subjected to the chloridizing roast, the ore is leached with hyposulphite solution in sixteen 14-ton vats, one of which is emptied daily. Next the silver is precipitated with calcium sulphide, giving a product containing from 40 to 50% silver and 1 oz. gold per ton. The tailing from the lixiviation, together with ores low in silver, is concentrated for the tin content by the methods described above. The high cost of power accentuates the cost of inefficient methods.

The two mills mentioned last in the list, as re-working tailing, are situated below the city of Potosi and have no mines of their own. They are engaged solely in concentrating the tailing that escapes from the mills up-stream, and their success plainly indicates the heavy losses from which the regular mills are suffering.

Smelting. Twenty years ago there are said to have been no less than 9 tin-smelting furnaces in continuous operation at Potosi. This number was reduced as it became necessary to go farther and farther for fuel. Finally, with the advent of the railroad in 1912, tin-smelting practically ceased. This was because the railroad in its endeavor to secure back-haul to the coast made such favorable rates on the concentrates that it became cheaper to ship than to smelt. At the time of my visit, in 1914, the furnace of Bebin Frères had not been run for over a year, while that of Louis Soux had been running intermittently on old slag that could not be concentrated. These furnaces are small water-jacketed blast-furnaces.

The charge formerly used by Bebin Frères consisted of

100 lb. tin ore or concentrate
60 lb. charcoal
5 to 10% limestone

The fine was briquetted with 5% of lime before being charged. Coke was occasionally substituted for charcoal, but it is said to have made a fire too hot for the furnace. The limestone came from a distance of 12 miles, and the charcoal from 24 to 30 miles. The costs of fuel at Potosi are as follows:

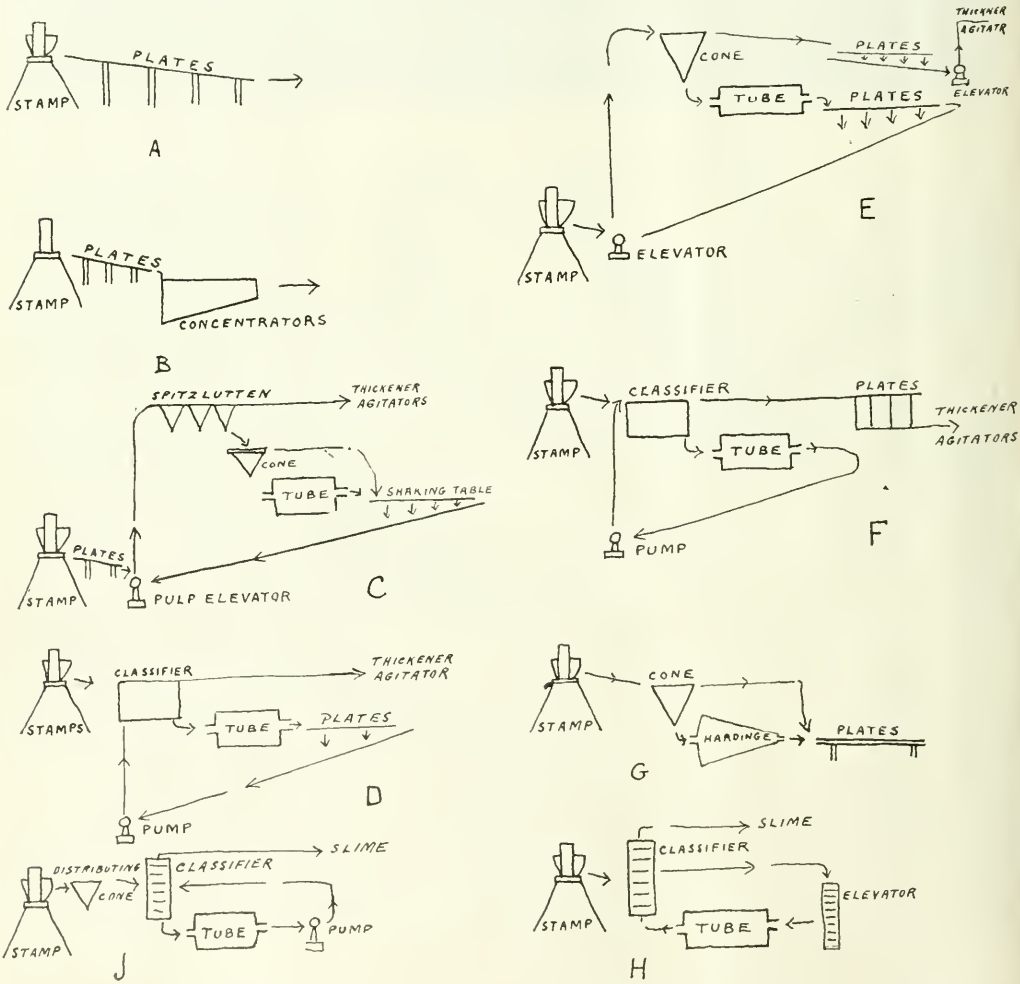
	Per ton.
Queuña charcoal	$36
Churqui charcoal	40
Cardiff coal	42
Coke	60

Louis Soux was smelting old slag containing from 4 to 7% tin, briquetting the fine with 10% lime, and claimed to be getting bars running from 94 to 96% tin and a slag containing only ½% tin.

The Position of the Tube-Mill

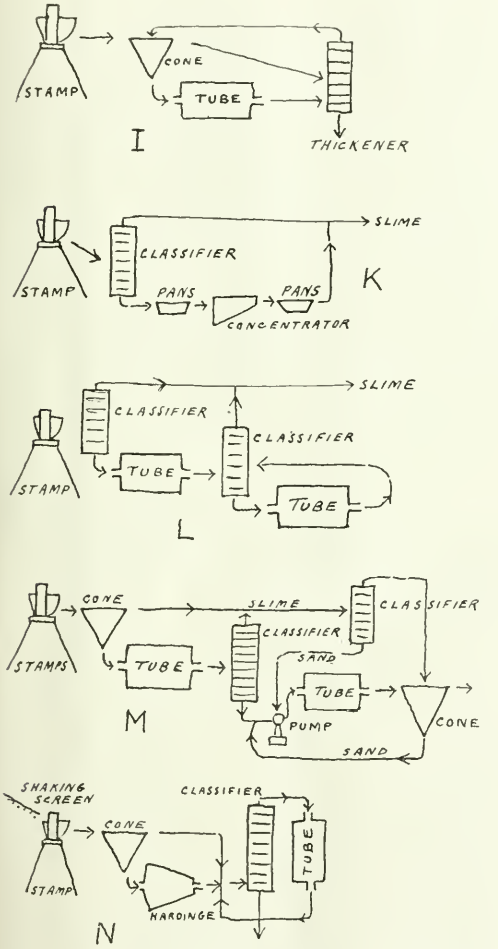
By ALGERNON DEL MAR

The millman must recognize the fact that the tube-mill has come to stay; whether we amalgamate after stamping or not, we must fix the position of the tube-mill in respect to the stamps and classifiers so that the whole process of extraction is benefited. The most important modification noticed in stamp-milling in consequence of re-grinding in tube-mills is that the point in the process at which the gold is extracted by amalgamation has changed. In times past the gold was always amalgamated in the mortar of the stamp-mill and the plates were immediately in front of the battery. We then saw the plates go to a separate building, still taking the pulp from the stamps; then with the advent of the tube-mill in the metallurgical treatment of gold ores the plates were placed in the tube-mill circuit and abandoned in front of the battery; then amalgamation was tried in the tube-mill and classifier circuits; then we find amalgamation taking place in the tube-mill and not in the stamp-mortar, and then amalgamation was confined to the classifier circuit. Nearly the whole cycle of possible combinations has been tried, and, like many other problems in gold extraction, we must study each



particular ore as a distinct problem. The simplicity of amalgamating after classifying and before thickening looks promising, but unfortunately we have no published data comparing this method with battery-amalgamation.

The following diagrams show the flow-sheet for a free-milling ore without the tube-mill; then the various positions of the tube-mill in respect to stamps with amalgamation as a feature; then the position of the tube-mill in the all-cyanide process.



A represents an absolutely free-milling process as at the Yellow Aster mill, California, where the whole process of extraction is in the battery and on plates.

B shows amalgamating in the stamp-battery, on plates, saving the concentrate, as in the usual California mills.

C. The plates are in front of the battery and likewise after the tube-mill.

D has tube-mill plates, but none in front of the stamps.

E has plates after the tube-mill and classifier.

F has plates after the classifier.

G shows amalgamation inside tube-mill, and in the tube-mill and classifier circuits.

We then have various modifications of the all-sliming process, using cyanide as the sole means of extraction.

H indicates the tube-mill taking sand from a Dorr classifier and returning ground pulp to the same, the elimination of slime being from the classifier.

I. The tube-mill takes the underflow from the cone, the overflow of the classifier, the tube-mill product going to a classifier, and the sand to a cone.

J. A distributing cone feeds a classifier, the elimination of slime from the circuit being from the classifier.

K. The stamps feed direct to a classifier, the oversize going to pans and concentrators. The slime is eliminated at the classifier, to which is added the product from the last pan, which can hardly be called all-sliming, but could be converted into such by returning the pan-overflow to the classifier.

L. Two tube-mills and two classifiers working in a closed circuit, the slime being separated from both classifiers.

M. Cone classifiers and tube-mills in a closed circuit, the slime being separated in the last cone.

N. Shaking screen before stamp, oversize to battery, undersize joins battery-discharge, both going to cone, undersize from cone to classifier, oversize of cone to Hardinge mill, cylindrical tube-mill in closed circuit classifier, slime eliminated from classifier. This is probably the most complete stage-reduction, as each machine is doing the work for which it is best fitted.

These diagrams represent the procedure in the several plants indicated, and while it does not exhaust the possible combinations, it is sufficiently extensive to show the great variety of processes of ore reduction now used for gold extraction by amalgamation and cyanidation.

Galvanized sheets are made by passing black sheets of steel, after the surfaces have been thoroughly cleaned and prepared, through pure molten zinc. By this process the surfaces are uniformly covered with an adherent coating of zinc, which entirely excludes the oxygen and moisture of the atmosphere, and inasmuch as the solution pressure, or, in other words, the corrodibility of zinc is very low, the life of such a sheet under weather conditions, even without being painted, is remarkably long. In addition to the direct exclusion of the elements, zinc has another property that makes it an excellent protective medium for iron and steel. When two dissimilar metals are coupled together and exposed to an electrolyte, an electric current will pass from one to the other, due to the difference in potential of the two metals. And the one which is electro-positive to the other will waste away while the electro-negative metal will not be acted upon. Zinc is electro-positive to iron or steel. Thus it will be readily seen that when the two metals are in contact and exposed to the weather, we have all the conditions of a simple battery, the moisture acting as the electrolyte and a minute current passes from one to the other, and the electro-negative iron or steel is protected at the expense of the zinc.

Concentration of Gold in Bottoms in the Converter

By H. F. COLLINS

*Experiments have been made from time to time in the direction of utilizing the gold contents of converter copper not rich enough in the precious metals to make electrolytic refining profitable, by means of a partial oxidation of the bath of white metals to 'pimple' metal and 'bottoms,' and the separation of the latter before completing the oxidation. Hitherto, however, the method has never come into regular use, partly, perhaps, because copper containing much gold usually contains also silver, which is not concentrated in bottoms to any great extent, and so far as I am aware no results have been published.

The method invented and patented by M. David, namely, the use of the 'selecteur,' a bowl-shaped pocket provided with separate tap-hole and fixed to the converter, into which the refined bottoms were collected by turning the converter partly down, so that upon turning up again the 'pimple' metal returned to the bottom of the converter while the copper remained in the pocket and could be tapped out separately, has not been extended beyond the original works where it was first tried, and I am not aware whether or not the 'selecteur' is still in use at those works.

Another method tried experimentally with some success is that of turning down the converter after partial blowing, and pouring the supernatant 'pimple' into a ladle for transfer into another converter, leaving the small charge of bottoms to be poured separately, either by itself, or after another charge of metal has been similarly blown, so as to accummulate a sufficient amount of bottoms for pouring. This method is quite practicable, but it introduces an additional complication into the routine of the converter plant, which is generally pushed to pretty near the capacity of the existing stands, and it introduces a difficulty in that the loss of heat in transfer is generally so great as to interfere with the finishing of the charge. 'Pimple' is notoriously difficult to blow unless exceptionally hot; upon blowing in the second converter after transfer great noses are apt to form on the tuyeres, and the charge is liable to freeze unless it be heated up by addition of some low-grade matte or sulphide ore, which has the disadvantage of reforming slag upon charge which has been skimmed clean.

The simple method devised by me, and carried out in actual practice since the summer of 1914 in small acid-lined converters, is that of providing the converter with a cast-iron tapping-block fixed opposite the tuyeres, having a tap-hole 1½ in. diam. When the lining is being rammed this hole has an ordinary ¾-in. steel bar pushed through up to within an inch of the mold, so that the lining may be rammed round it as tightly as possible, and when the molds are removed the bar is at the same time withdrawn in order to facilitate 'drying out.'

When the converter is placed upon the stand for use the tap-hole is closed by a plug of clay, and a short ¾-in. bar is then driven in so as just to protrude inside the lining while the head stands out some 16 to 20 in. from the front of the converter-shell. After blowing to precipitate as metal the required quantity of copper, the converter is turned down till the bar stands at about 75° from the horizontal.

After knocking it in an inch or so in order to penetrate any skin of copper that may have formed on the inside, the usual ring and wedge are affixed, and the bar is driven out as quickly as possible by rapid blows; as its point leaves the converter-shell the mold car held in readiness at the back is rapidly pushed forward, while the converter is at the same time turned until the tap-hole is vertical.

After one, two, or three molds have been filled, according to the size of the charge, and the issuing stream is evidently white metal and not copper, the converter is turned up as rapidly as possible, the tap-hole being plugged with clay while in motion until the next operation, and blowing is re-started to finish the charge as usual.

The success of this operation as carried out in small acid-lined converters (the so-called 3-ton size) depends primarily upon running the charge hot, not losing too much time in skimming, and not adding too much cold scrap after skimming, so that the reduced copper is at a temperature much above the melting point of the 'pimple' metal, otherwise it is liable to chill in the tap-hole. Provided the charge is hot enough, all that is required is smartness on the part of the attendants in getting out the bar quickly and in carrying out the various movements necessary.

At first, owing to lack of smartness in driving out the bar, the copper in many cases would chill in the tap-hole, and after driving and withdrawing the bar repeatedly could not be got out, so that in order to avoid chilling the charge it had to be finished in the ordinary way without getting any bottoms. After a month's practice, however, with the help of a small bonus on each charge of bottoms successfully tapped, the men have become so expert that they seldom miss getting out the bar smartly and tapping a charge from 60 to 120 kg. of bottoms without spilling more than a few kilograms of metal on the floor, and without delaying the finishing of the charge more than two or three minutes. The method of tapping the converter for bottoms is therefore no longer experimental, but has taken rank as a working method.

*Abstract from paper read before the Institution of Mining and Metallurgy, London, on May 20, 1915.

TABLE II.

Time Blown. Min.	Bottoms. Kg.	Bottoms. Total Kg.	Assays of Bottoms. Gold.	Assays of Bottoms. Silver.	Residues Kg.	Residues Total Kg.	Assays of Residues. Gold.	Assays of Residues. Silver.	Total Weight Gold Contents Grm. Bottoms.	Total Weight Gold Contents Grm. Bars.	Calculated Contents Original. Total Grm.	Calculated Contents Original. Per Ton.	% of Total Gold in Bottoms.
22	132	..	..	..	1302	..	..	..	..	..	..	..	..
22	67	..	..	..		..	..	..	..	..	..	..	..
20	7	..	..	..	3944	..	..	..	..	..	..	..	..
20	138	..	..	..		..	..	..	..	..	..	..	..
21	130	..	..	..	954	..	..	..	..	..	..	..	..
20	72	..	..	..	766	..	..	..	..	..	..	..	..
19	87	..	..	..	..	..	..	..	..	..	..	..	..
20	122	..	..	..		..	..	..	..	..	..	..	..
20	143	898	172	1384	2136	9,102	6	780	154·45				
						..				66·45	233·54	19·4	71·5
20	32	..	..	..		..	..	..	..				
22	8	40	316	1176	1974	1,974	6	780	12·64				
		..				..							
20	26	26	622	1674	1817	..	..	..	..	..	..	..	..
		..				..	..	..	..	..	..	..	..
22	77	..	..	..		..	..	..	..	..	..	..	..
20	73	..	..	..		..	..	..	..	..	..	..	..
20	116	..	..	..	2518	..	..	..	..	..	..	..	..
20	72	338	144	1516		4,335	10	966	64·84	43·35	108·19	23·0	59·9
		..				..							
22	22	..	..	..	..	..	..	..	..	..	..	..	..
20	90	..	..	..	..	..	..	..	..	..	..	..	..
22	102	214	231	1572	2483	2,483	8	1016	49·434	19·864	69·30	25·7	71·3
		..				..							
20	70	..	..	..	385	..	..	..	..	..	..	..	..
20	108	..	..	..		..	..	..	..	..	..	..	..
20	45	..	..	..	3080	..	..	..	..	..	..	..	..
20	105			..		..			..	..	..	..	
20	85	..	..	..	1977	..	..	..	..	..	..	..	..
20	31	..	..	..		..	..	..	..	..	..	..	..
22	70	514	200	1562	661	6,103	8	1016	102·800	48·824	151·62	22·9	67·8
		..				..							
20	24	..	..	..	..	..	..	..	..	..	..	..	..
20	84	..	..	..		..	..	..	..	..	..	..	..
20	77	185	282	1571	3366	3,366	8	1016	52·17	26·928	79·10	22·3	66·0
		..				..							
19	92	..	..	..	964	..	..	..	..	..	..	..	..
20	102	..	..	..		..	..	..	..	..	..	..	..
22	108	..	..	..	2857	..	..	..	..	..	..	..	..
18	123	425	144	1516			..	..	..	..	..	..	..
		..				..							
18	12	12	622	1674	678		..	..	..	..	..	..	..
		..				..							
20	95	..	..	..	2889	..	..	..	..	..	..	..	..
22	81	..	..	..		..	..	..	..	..	..	..	..
18	62	..	..	..	..	..	..	..	..	..	..	..	..
22	100	338	144	1516	796	8,184	8	966	117·34	65·47	182·81	20·4	64·2
		..				..							
18	82	..	..	..		..	..	..	..	..	..	..	..
18	77	..	..	..		..	..	..	..	..	..	..	..
20	98	257	200	1562	2873	..	..	..	..	..	..	..	..
		..				..							
20	10	..	..	..		..	..	..	..	..	..	..	..
20	7	17	504	1674		..	..	..	..	..	..	..	..
		..				..	..	..	..	..	..	..	..
20	45	..	..	..	887	..	..	..	..	..	..	..	..
18	80	..	..	..		..	..	..	..	..	..	..	..
20	79	204	200	1560	1781	5,541	10	1016	100·77	55·41	156·18	25·9	64·5
		..				..							
20	102	..	..	..	912	..	..	..	..	..	..	..	..
20	96	..	..	..		..	..	..	..	..	..	..	..
24	57	..	..	..		..	..	..	..	..	..	..	..
25	36	..	..	..	4032	..	..	..	..	..	..	..	..
20	130	..	..	..		..	..	..	..	..	..	..	..
22	160	..	..	..		..	..	..	..	..	..	..	..
20	69	..	..	..		..	..	..	..	..	..	..	..
20	64	..	..	..	2372	..	..	..	..	..	..	..	..
18	65	..	..	..		..	..	..	..	..	..	..	..
20	72	..	..	..		..	..	..	..	..	..	..	..
20	41	..	..	..	2637	..	..	..	..	..	..	..	..
20	115	..	..	..		..	..	..	..	..	..	..	..
22	103	..	..	..	803	..	..	..	..	..	..	..	..
20	83	..	..	..		..	..	..	..	..	..	..	..
20	95	..	..	..	4624	..	..	..	..	..	..	..	..
20	78	..	..	..		..	..	..	..	..	..	..	..
20	62	1419	164	1584	881	16,261	8	1005	232·72	130·09	362·81	20·5	64·1
		..				..							
26	60	..	..	..		..	..	..	..	..	..	..	..
22	76	..	..	..		..	..	..	..	..	..	..	..
22	108	..	..	..	4264	..	..	..	..	..	..	..	..
20	55	..	..	..		..	..	..	..	..	..	..	..
22	113	..	..	..		..	..	..	..	..	..	..	..
22	81	..	..	..		..	..	..	..	..	..	..	..
22	38	..	..	..		..	..	..	..	..	..	..	..
24	124	..	..	..	5370	..	..	..	..	..	..	..	..
20	115	..	..	..		..	..	..	..	..	..	..	..
20	117	..	..	..		..	..	..	..	..	..	..	..
22	117	..	..	..		..	..	..	..	..	..	..	..
20	67	..	..	..		..	..	..	..	..	..	..	..
20	65	..	..	..	3023	..	..	..	..	..	..	..	..
20	102	..	..	..		..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..
20	198	1436	136	1404	3869	16,526	7	812	195·29	115·68	310·97	17·3	62·8
		..				..							
Charges..	79	6323	171	1497	..	73,875	8	924	1082 454	572·066	1654·52	20·6	65·4
= oz. per ton.			5½	48·3			0·26	26·2					

As regards the concentration of gold in the bottoms, in practice it is easy to recover 70% of the gold originally existing in the charge in the form of bottoms, amounting to 9% of the total weight of copper produced, and 25 times as rich. The richness of the bottoms in gold depends upon the relative proportions of bottoms and residue-bars from each charge, and the following table gives the results of the first few charges tapped, omitting three or four in which the bottoms could not be got out, owing to chilling in the tap-hole.

In this table all the assays for gold and silver are given in grams per metric ton of 1000 kg., which is not only scientific and highly convenient to those who are accustomed to metric weights, but it is the system in common use in Spain and most other European countries as well as in Spanish America. One troy ounce is 31.1035 grams.

As will be seen, the richest bottoms were those of charge No. 6, which contained at the rate of 1976 gm., or over 60 oz. per ton. The quantity, however, was so small that the concentration of gold was imperfect, only 44%. Even this, however, is a noteworthy result, considering that the bottoms represent only one two-hundredths part by weight of the total charge. A more remarkable result is that of the first charge blown, which yielded 12½ kg. bottoms assaying 1216 gm., or nearly 40 oz. per ton, in which small quantity, only 2% by weight of the entire charge, no less than 74% of the total gold present was concentrated. The third charge apparently shows a very poor concentration, but in this case there is no doubt that the greater part of the bottoms remained behind in the converter, owing to not turning down far enough during the tapping pour, or to turning up too soon, and so contaminated the residue-bars instead of being recovered as bottoms.

The highest degree of concentration appears to be reached when the bottoms amount to 15% of the total copper produced, in which case they carry about 85% of the gold present. Good results in practice are, however, attained when of the total copper produced only 10% is 'bottoms' and 90% 'residues,' provided that in every case the whole of the bottoms is poured clean, and none left to contaminate the residue. The recovery of gold still averages 65% of the total present even when the proportion of bottom is only 8% of the total copper recovered.

Table II shows the actual results obtained from a large number of *consecutive* charges tapped during a part of the month of December 1914. It will be noted that once the workmen have acquired the necessary experience great variations in the weight of bottoms tapped from each charge are rare, and the proportion of the total gold concentrated in the bottoms is fairly regular. The average rate of concentration would be even better, but for the fact that in order to avoid tapping a large quantity of 'pimple' metal with the copper, all of which would have to go back to another charge as scrap, a portion of the reduced copper is sometimes allowed to stay behind in the converter, and so contaminates the residue-bars. In some cases, however, when the operation has been properly conducted the residue copper has been got as low as 2 gm. per ton, while still showing a concentration of 90% of the gold in the bottoms.

In order to obtain good results, it is necessary to hit the point of 'white metal' with considerable nicety before the final skimming prior to commencing the blowing for bottom, since if the white metal is low and contains more than 4% iron, as occasionally happens when the skimmer is either careless or timid, the time required for oxidation of the excess iron will vitiate the calculation of that required for blowing to 'bottoms'; and insufficient copper will be reduced. Provided, however, the point at which the white metal is skimmed be kept fairly uniform, it is only necessary to proportion the time for 'bottom-blowing' roughly to the size of the charge. In the particular case under consideration where the bars weigh 70 kg. a very small first charge of only 10 bars will have enough with 17 to 20 minutes, whereas a charge of upward of 20 bars will require from 24 to 26 minutes.

The concentration of silver in the bottoms is, as the tables show, and as might be expected, comparatively poor, the average assay of the bottoms being 1497 and of the residues 924 gm. per ton. So far as it goes, however, it is an advantage, since it gives to the bottoms an extra value of something like $10 per ton. The average percentage of copper in the bottoms is about 98% as compared with 99.15% for the residue-bars. This is due to imperfect elimination of such impurities as Fe, S, Pb, Ni, As, etc., from the first copper reduced, and is of no importance, seeing that the bottoms in any case have to be refined electrolytically.

TABLE I

Time blown, min.	Bottoms, kg.	Assays of bottoms — Gold.	Silver.	Residue, kg.	Assays of residue — Gold.	Silver.	Total weight gold contents, gm. — Bottoms.	Bars.	Calculated contents original — Total gm.	Per ton.	Total gold in bottoms, %
15	12.6	1216	552	630	8	696	14.59	5.04	19.63	30.0	74.0
20	330.0	72	960	Charge froze			23.76	....	....	....	....
16	9.0	384	1248	630	16	832	3.46	10.08	13.54	21.0	25.5
18	118.0	84	1188	Charge froze			9.91	....	....	....	....
18	64.0	278	1408	630	4	712	17.79	4.41	22.20	32.0	80.1
18	4.0	1976	136	840	12	864	7.90	10.08	17.98	21.3	44.0
21	113.0	148	1176	685	4	638	16.72	2.74	19.46	24.4	85.9
21	129.0	152	1252	874	4	588	19.61	3.50	23.11	23.0	84.9
20	135.0	128	1064	607	4	540	17.28	2.43	19.71	26.5	87.7

In the case of copper that contains, say, ½ to ¾ oz. gold and not much silver, it is evidently a great advantage to be able to concentrate, *at practically speaking no additional cost*, from two-thirds to three-fourths of the gold into 8% by weight of bottoms for electrolytic refining, and worth at least $120 per ton more than the original copper, the remaining 92% of the output taking the form of residue-bars, practically free from gold, and which therefore can be refined in a reverberatory direct to 'best selected' copper and sold as such.

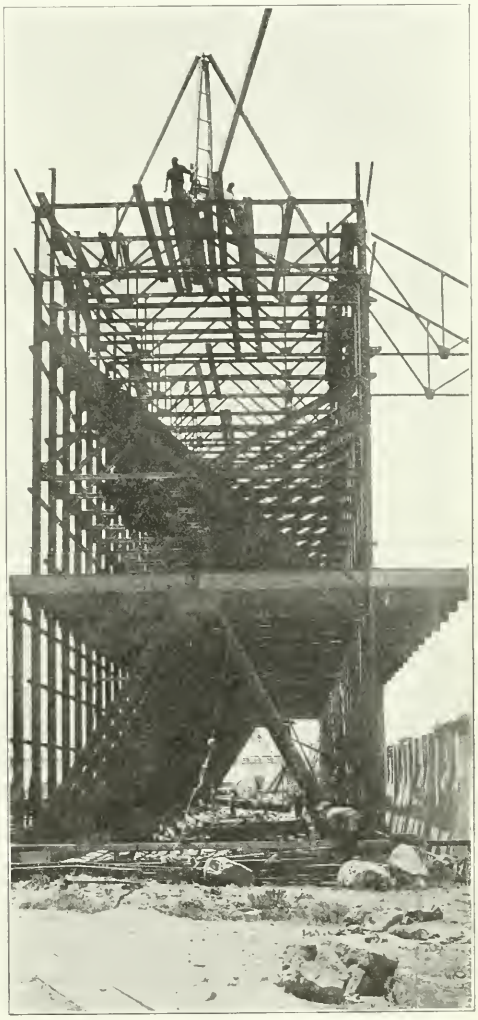
The method of gold concentration in converter-bottoms described is no longer experimental, but has become standard practice at Cueva de la Mora since the month of November 1914; it is rumored that a neighboring plant intends to pay us the compliment of experimenting in the same direction.

I take pleasure in acknowledging the valuable assistance received from my metallurgical assistant, Mr. William Spalding, in carrying out these experiments, and in installing the method as part of our regular routine. [The theory of this process has been studied by Edward Keller, *Mineral Industry* vol. IX, P. 240, *Trans.* A. I. M. E., vol. XXVIII, 127. also by Allen Gibb, 3rd Report Alloys Research Committee, Institution of Mech. Eng., 1895.—Editor.]

Ore-Bin Construction

There are many types of ore-bins in stamp-mills throughout the world. Some engineers prefer flat-bottom bins, others sloping, and others again half flat and half sloping. Flat bins give additional storage. Sloping bins are self-emptying. Ore-bins have great weights to hold, besides the impact of ore being continually dumped into them, either out of cars or from belt-conveyors. The vibration from the stamps is also a strain on bins. The support of a bin is all-important. Bins sometimes collapse from lack of sufficient supports. They are generally built of wood, except in smelters, where they should be of steel. The accompanying photograph shows a large steel bin being erected on the Rand. It is of the sloping type, well braced under the joists. The camshaft floor is part of the structure, being visible above the concrete foundations for the mortar-boxes. The wear on a wooden bin is heavy, especially on the floor and around the discharge-gates. There is also the liability to catching fire. Steel bins might be attacked by acid in the mine-water mixed with the ore. They would probably take longer to erect than wood, and may cost more where wood is cheap. But they offer several advantages over wooden ones. On the Rand, timber is expensive, Oregon pine being used for the most part. Recent practice is to use steel and concrete to a large extent. Bins may be wholly of steel, or a steel frame lined with wood. Good foundations are highly important, and the posts should be fitted into steel or cast-iron plates bolted to the foundations. Ore-bin design offers much opportunity for study to engineers and the importance of the matter justifies careful attention.

The deepest well in the world is in Upper Silesia, in Germany. It is a diamond-drill hole in a coalfield and is 7350 ft. deep. A well in the United States which may go deeper, according to the U. S. Geological Survey, is four miles northwest of McDonald, Pennsylvania, and about 15 miles west of Pittsburg. This well, which is being sunk to the Medina sandstone—a bed that elsewhere contains oil and gas—is now 7174 ft. deep. Some



STEEL ORE-BIN CONSTRUCTION ON THE RAND.

gas and oil were found in the upper part of the well. Between the depths of 6830 and 7100 ft., rock-bearing salt and salt water were encountered. These are regarded as of Salina age, the same as those carrying rock salt in western New York. The temperature in this well at the depth of 6775 ft. is 145 °F.

Testing Working Cyanide Solutions

According to Edward H. Croghan in the April issue of the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, great diversity of results may be obtained in testing working cyanide solutions, and a suitable uniform procedure which should be adopted on the Rand is highly desirable.

In working solutions with zinc precipitation in vogue, solutions containing both free cyanide and cyanide existing as double zinc cyanide, there are in titrating with silver nitrate in the presence of potassium iodide as indicator, two end points that can be observed: (1) the first appearance of a distinct opalescence or permanent flocculent whitish precipitate; (2) following on (1) the appearance of a distinct permanent yellowish tint. The first point is presumed to approximately give the figures for free cyanide content, and the second depending chiefly on whether there is present or not sufficient free alkali and the dilution, the whole or a part of the total cyanide. Subsequent references to the above two finishing points will be briefly termed the white and yellow points, respectively.

There does not seem to be uniformity in the matter of testing. It is in consequence interesting to note that, supposing a test were made on a strong solution to the yellow point, and 0.12% KCN found the more correct result for *free* KCN, if the titration had been conducted to the white point, might only be 0.06%. On slime solutions the same result could occur, 0.015% KCN according to the yellow point might not be on the white more than 0.008% free KCN, and possibly less.

In the course of testing some working solutions for free cyanide, he noted the percentage of so-called free cyanide according to the white or yellow points previously referred to, and continuing the determination for protective alkali on the same solution which had been titrated by silver nitrate with potassium iodide as indicator.

The tests made result in the following conclusions for KCN: (1) The white point results of both methods are much lower than those of their respective yellow. (2) The yellow point data of the ordinary method are a good deal higher than those of the yellow under the special process—in fact, the former almost correspond to the total cyanide found, particularly on the weak solutions. (3) The white point percentages of the ordinary method fall interestingly between those of the white and yellow of the special procedure, with two minor exceptions. From the analyses it is indicated that neither the white nor the yellow point data of the special method can lay claim to being in closer agreement with those of the white point of the ordinary procedure.

Regarding protective alkali, the following is deduced; (1) Comparing the protective alkali results obtained by the ordinary method on solutions which had been titrated for free cyanide, that is, to the white point, with those of the special method, on the weak cyanide solutions the agreement on the whole is close, but on the stronger the former tends to be higher. (2) The protective alkali figures found under the ordinary method on the solutions titrated to the yellow point with silver nitrate, are on the average distinctly lower than those secured on the white point of the ordinary, and seemingly, though to a lesser extent, lower compared with the data yielded by the special method. The estimation of protective alkali on a yellow point solution is very unsatisfactory owing to the disappearance and slow faint reappearance of the purple-red of the phenolphthalein indicator, in fact any result might be obtained on a quick titration and not looking out for this recurrence. His titrations were slowly done until after about a quarter of a minute no trace of color developed. If in the titration with silver nitrate in the first instance the yellow point be overdone, and it is fairly easy to do so in a bad light, the protective alkali figures will be found to be much lower. One of the theories advanced is that the lower alkalinity estimated may be due to the formation of zinc nitrate, which in turn would react with the alkali, and so lessen its amount. Under the special method of determining the protective alkali, this difficulty is obviated chiefly by the addition of a slight excess of potassium ferrocyanide, which regenerates the alkali. Mr. Croghan discussed Clennell's remarks on the finishing point of permanent yellowish turbidity.

The following methods were employed by the author:

Standard silver nitrate=6.523 grams per litre. Using 50 cc. sample for testing, 1 cc. standard silver nitrate =0.01% KCN.

Ordinary method for free cyanide: to 50 cc. sample add 5 drops of 10% solution of potassium iodide. Titrate with standard silver nitrate to first distinct flocculent whitish precipitate, which after agitation remains permanent for about half-a-minute.

For protective alkali: to the solution used above for free cyanide, add 8 to 10 drops of 0.5% neutral alcoholic solution of phenolphthalein and titrate with standard acid as usual until the color has quite disappeared. For the yellow point results proceed on similar lines.

Total cyanide: to 50 cc. sample add 5 to 10 cc. of 4% solution of sodium hydrate containing 1% potassium iodide; titrate with standard silver nitrate to yellow tint.

Special method. (Clennell) free cyanide: (1) Determine the total cyanide as above. (2) To another lot of 50 cc. sample, add slightly more (about 0.2 cc.) than the amount of silver nitrate found to be required for the total cyanide, together with a slight excess of potassium ferro-cyanide. Then 8 to 10 drops of phenolphthalein are added to the turbid liquid and the mixture titrated (without filtering) with standard acid (*N*/10 sulphuric acid) until the pink just disappears. (3) To a third 50 cc. of the original sample add gradually with agitation the amount of acid required under (2). Five drops of 10% potassium iodide solution are then added and the mixture titrated with silver nitrate until a distinct flocculent whitish precipitate remains permanent for about half-a-minute.

Protective alkali: this is the result as found under (2).

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Centrifugal force comes into play when the speed of a belt exceeds about 4000 ft. per minute.

Flotation, apart from crushing of the ore and treatment of the concentrate, costs about $1 per ton at Broken Hill.

Salt lake is 5½ times more salt than the ocean and the density of its water is 14.5% greater than that of fresh water.

Playa is the name given to shallow flat-floored depressions, characteristic of valleys having no regular drainage to the sea.

Gypsite is finely divided gypsum, lime sulphate, mixed with other matter that does not interfere with its use for cement plaster.

Bentonite is a white clay of the finest quality found in the Benton shale of Wyoming. It is used in antiphlogistine; also to adulterate candies and drugs. It will absorb seven times its volume of water.

Common gases in coal mines are as follows: carbon dioxide (CO_2), carbon monoxide (CO), ethane or olefiant gas (C_2H_6), ethene (C_2H_4), hydrogen sulphide (H_2S), and methane or marsh gas (CH_4). Hydrogen, nitrogen, and oxygen also occur in these gases.

Columnar structure in rocks, notably basalt, is due to contraction on cooling. The prismatic shrinkage-cracks start at right angles to the cooling surface. If the rock were perfectly homogeneous and cooled uniformly, the columns would all be hexagonal and of uniform thickness.

Metal sheet roofs are clean and sanitary, so that, where necessary, water from them can be collected into cisterns used for domestic purposes. Having no gravel and tar the surface is not apt to clog up eave trough and conductor pipes as is often the case with so-called 'slag' roofs.

That ordinary dynamite and gelatin dynamite will freeze, and become less sensitive at temperatures between 45° and 50°F., is well known. It is not so widely understood that such dynamite may be chilled to an extent that materially lessens its effectiveness without becoming hard, and without exhibiting any physical difference that would readily distinguish it as being in poor condition.

Refining gold by chlorine gas, as practised at the three mints in Australia is well adapted to the rapid refining of gold alloyed with varying proportions of silver and base metals. The latter may include every metal known. The process is applicable to bullion containing from 99% gold, 1% silver and base, to 1% gold, and 99% silver and base. Chlorine gas of 5 to 6-lb. pressure is suitable. All base metals are converted into chlorides and expelled, and silver chloride floats on top of the pure gold.

Advantages of the electric-furnace compared to the blast-furnace for melting high-grade gold slags are as follows, according to W. P. Lass: a saving in mechanical loss of gold in flue-dust, because the melting is done in a quiet neutral atmosphere, instead of in a rising blast of air; the obtaining of a lower-grade slag, free from shot, by reason of the quieter melting action and the higher temperature obtainable, making a more fluid slag; the nicety of regulation of the melting temperature; and the benefit to the general health of the operators.

Link-belting is made of short lengths of selected leather united by rivets around which the links pivot. This gives a flexible belt suitable for short drives, for which rigid leather belts would be unsuitable, but it is, of course, also adapted to heavy main driving. In the transverse direction link-belts are too rigid to lie round a curved face. But by fitting a flexible series of double links down the centre, with or without curving of the other links transversely, they will fit pulleys having a large amount of crowning, without slip of the belt or strain of the rivets. There is no air-cushion when a link-belt is running.

Copper added in small quantities greatly prolongs the life of iron. Very small quantities are needed to effect this result. If to one thousand pounds of iron, two pounds of copper be added, the resulting alloy will dissolve in acid only one-tenth as fast as pure iron does; and in the atmosphere the corrosion will be only one-third as rapid. An increase in the copper up to 7% of the alloy does not increase the power of the iron to resist corrosion. Copper, 0.2%, will yield as good an alloy for resisting rust and corrosion as does 7%, and the resulting alloy is less expensive on account of the smaller amount of copper required.

In acetylene gas manufacture, calcium carbide wetted with water, considerable quantities of so-called carbide slime are always left in producers. The slime is a waste product, no means of utilizing it having been known heretofore. In view of the large increase in the consumption of acetylene since the outbreak of the War, the report of R. Schumann on the possible utilization of carbide slime, published in the *Chemiker-Zeitung*, will be of special interest. The material could not be used as fertilizer, salts of phosphorus being absent, but might be used as water purifier when of a certain composition. The experiments with the employment of carbide slime as building material yielded the best results. When mixed with 40% of building sand, the carbide slime formed a usable mortar which set well and bound the bricks firmly. This new building material will be thoroughly tested by further experiments.

Japanese Minerals at the Exposition

The Japanese mining exhibit at the Panama-Pacific Exposition is one of the most attractive and instructive to be seen there. As it has been made by the Government with the cooperation of the mining companies, the individual exhibits were not entered in competition for the prizes, and a special commemorative medal has been awarded to the exhibit as a whole. A clear understanding of the status of the mining industry of Japan can be obtained from the exhibit of the Imperial Geological Survey. This includes a systematic collection of the minerals and fossils of Japan, supplemented by a similar collection of the economic minerals of Japan. Large maps and wall-diagrams make clear the significance of these, and the publications of the Survey are also on view. Of more popular interest are the photographs and relief-models of Sakurajima, showing the crater before and after the eruption of 1913, which resulted in the loss of so many lives. These are supplemented by blocks of lava, volcanic ash, tufa, and lapilli thrown out during the eruption. A similar exhibit is made for the volcano called Aso.

The largest mining company in Japan is the Mitsu Bishi & Co., which owns 15 metal mines, producing copper, gold, silver, lead, zinc, tin, and tungsten, and 8 coal mines, the value of the annual production in 1913 being $18,500,000. This company has filled a large case with a systematic collection indicating its various activities. Coal, copper ore, iron ore, blister copper, anodes, refined copper, copper sheets, blue vitriol, printing-rolls made from copper, and various other finished products are shown. Some unusually fine mineral specimens are displayed, proving the great variety of ores mined by this company. Furukawa & Co., the largest copper-mining company in Japan, has made an especially attractive exhibit. Copper ore from the Ashio and Kobe mines is shown in quantity, also coal from the three collieries owned by this company. Of the various copper mines a typical block of ore is exhibited and next to it is a bar of the blister copper made at that mine. The central feature of the exhibit is a collection of the finished products made from copper for which the Furukawa Co. has a high reputation. Those shown include copper wire of various sizes, trolley wire, copper rods and bars, and copper and brass sheets. This company owns 10 metal mines, producing copper, silver, gold, coal, lead, and zinc. The value of its output in 1913 was about $6,000,000.

The Mitsui Mining Co., which owns 5 coal mines and one silver-zinc mine, has made an excellent exhibit. Blocks of coal from its various collieries are displayed, coke from washed coal, heavy oil, creosote, light oil, napthalene, and ammonium sulphate in jars. Large samples of wolframite ore are on view, together with the concentrate therefrom. Crude and refined sulphur is displayed in large glass jars. Zinc-lead ore from Kamioka is shown together with bars of spelter. Electrolytically refined lead and bismuth are on view. The value of its products in 1913 was $7,000,000.

The neighboring case displays the products of the Sumitomo mines and works. Various samples of ore from the Besshi mine are shown, copper ingots, copper wire, sheets, and tubes, and brass wire, sheets, and tubes. The case is well arranged and is especially attractive. The operations of this company were described in the Mining and Scientific Press of September 21, 1912. Production in 1913 was valued at $3,500,000.

The Kuhara Mining Co. exhibits large blocks of ore from its various mines, with a display of copper cathodes, pigs of copper, and bars of silver bullion in the middle. Fujita & Co. has a similar exhibit, including blister copper, cathodes, bullion, also zinc oxide pigment, zinc dust, and zinc white for face powder. This company owns six mines and its production in 1913 was valued at $5,000,000.

The Imperial Steel Works has made a comprehensive exhibit. An exact model of the plant at Wakamatsu gives a clear idea of the magnitude and scope of operations. This is supplemented by photographs. An adjoining case contains blocks of iron and maganese ore, dolomite, firebrick, coke, and by-products from coke-ovens. Another case shows the various iron and steel products made by the plant.

Chobei Tanaka shows samples of iron, copper, and gold ore, coke pig-iron, charcoal pig-iron, steel bars, round and flat, angles, and rail sections. At its Kamaishi mine, this company produces pig iron, ferro-manganese, copper, silver, and gold, valued at over $2,000,000 in 1913.

The Hokkaido Colliery & Steamship Co., Ltd., has filled a large showcase with large blocks of coal from its various collieries, Sorachi, Yubari, and Manji, and pig iron made at its iron works.

The Nippon Oil Co. shows photographs of its wells and refineries, also jars of the numerous products made in refining. The exhibit is especially instructive since a jar of crude from each of the four productive districts is shown, and beside it other jars contain the relative amounts of gasoline, kerosene, light oil, and heavy oil. The output in 1913 was valued at about $2,000,000.

The Japan Sulphur Co. exhibits large blocks of crude ore, sulphur in large rolls, also flowers of sulphur, and the packages of sulphur packed for shipment. The Kaijima Coal Mining Co. exhibits large and small cubes cut from coal that are perfect enough to serve as building-stones. The Meiji Mining Co. has constructed a small mountain of coal, on which native miners are at work. A sample of gold ore from the Shojo mine, Korea, owned by the same company, is also exhibited.

Oregon Minerals at the Exposition

During June a display of minerals of Oregon was arranged in the Palace of Mines and Metallurgy at the Panama-Pacific Exposition. To enlighten visitors, the Oregon Bureau of Mines and Geology, H. M. Parks director at Corvallis, prepared a 40-page illustrated pamphlet for distribution briefly covering mining in the State. In 1913 the total mineral production of the State was valued at $3,563,919. Gold contributed $1,627,710 of this and clay and stone over $1,000,000.

In the centre of the exhibit is a relief map of the State. Posts at the corners are surmounted by glass jars of gold, copper, and lead-silver ores. In cases surrounding the booth are the following: (1) Coarse gold from the Powder River dredge at Sumpter. At present this is the only boat in Oregon. Its daily output is 50 oz. (2) Gold ore, mill products, etc., from the Union-Companion mines of the Cornucopia Mines Co., Baker county. With 75 men, 20 stamps, and cyanide plant, the annual output is $330,000. Ore, some showing tellurides, is also shown from the Last Chance mine of the Baker Mines Co. (3) Nugget weighing 80.4 oz., found at the Buck Gulch placer, Grant county, June 19, 1913; crystallized and leaf gold from the Humboldt mine, Malheur county; also Belmont mine, Grant county. Quartz gold pebbles from the Daggett placers, Grant county; platinum from Logan property, Josephine county, the largest platinum producer in the United States; ores and native copper from the Waldo district, Josephine county; and opal in matrix. (4) Specimens of petrified wood, marbles, granites, lime, and gypsum. (5) Samples of shell marl from Scappoose, Columbia county, used in cement manufacture; quicksilver and other ores. (6) This case is interesting from the old Indian pestle and mortars shown. On two sides of the relief map mentioned are six benches of four tiers each containing large samples of gold, copper, antimony, chrome, and other ores. Three cases display good polished stones and gems. The coal industry is represented by large pieces from Beaver Hill, Coos county. The sandstone of Lincoln county is shown, but in a larger way at the Call building, San Francisco, which was built entirely of it. Photographs of all phases of Oregon mining complete a well-arranged collection of minerals.

Placer mining has had a good season this year. A railway in the southeast is expected to stimulate languishing districts.

REVIEW OF MINING

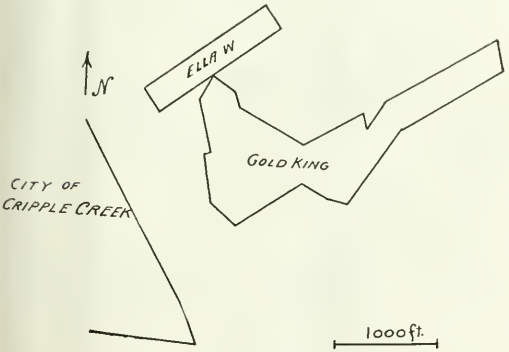
As seen at the world's great mining centres by our own correspondents.

CRIPPLE CREEK, COLORADO

Residue-Covered Claim Starts Suit.—Stratton's Independence.—Last Dollar.—Ella W. Discovery.—District Situation.

Stratton's Independence, Ltd., has been made defendant in a suit brought by Mrs. M. E. Brooks, of Denver, in the United States district court. It seems that the plaintiff owns a fractional mining claim adjacent to the Independence tailing-pond. For some time past residue from the mill has been dumped close to and partly on this claim. The plaintiff asserts that her ground has been damaged to the extent of $25,000, the amount sued for. It is well known that no work has been done on the claim for more than 10 years. The tailing has been on the ground for several years and nothing has even been said about it. Since the strip of ground claimed to be covered is about 50 ft. long, it is hard to see how damage to this amount has been done.

Much activity is being shown at the Independence mine. About 15 sets of lessees are already working. Some of them have a fair grade of ore opened. Numerous other parties are



PLAN SHOWING POSITION OF ELLA W. MINE.

looking over their blocks, trying to determine the most advantageous way of opening them. Development is being vigorously prosecuted on company account.

It is reported that the shaft on the Last Dollar property will soon be sunk another hundred feet.

Much interest is being shown in the development recently made at the Ella W. property on Tenderfoot hill. This claim lies just northeast of the city limits of Cripple Creek, and closely adjoins the Gold King claims. It was on the latter group that the first discovery of gold was made in the district. On the Ella W., lessees have opened on the surface an ore deposit the dimensions of which are still undetermined. The pit so far is about 12 ft. wide, and still there is ore on both sides. In length the ore has been taken out for about 50 ft., with no signs of the ore cutting out in either direction. From the surface it looks like a huge blow-out. The ore is an oxidized porphyry, and pieces can be found which show flakes of free gold. The first shipment from the open-cut settled for a little less than $20 per ton. Two other shipments have been made, but the returns have not yet been received.

The general condition of the district is quiet with steady output. If the deposit at the Ella W. proves persistent and near the present value, it will mean considerable activity in a part of the district which has long been quiet.

TORONTO, ONTARIO

Porcupine and Cobalt Mines' Development.

Dome shares have recently shown a strong upward tendency. The advance is shared by other Porcupine issues. On the other hand, Cobalt shares were generally weak and inactive. The cause of this is the reduction in the price of silver. The increased interest in the Dome is due to reports of a decided improvement in the grade of the ore being developed on the fifth and sixth levels. This is stated to be worth about $10 per ton for a distance of 200 ft.——At the Vipond a rich shoot has been opened in the Davidson vein at 200-ft. Good ore has been cut in the winze being put down from 300 to 400-ft. but the vein faulted at 48 feet.

The Porcupine Crown has materially added to its ore reserves. The fault in the vein has disappeared at the 600-ft. level, where the vein shows increased width and retains its grade.——As a result of their recent visit of inspection to the mine the directors of the McIntyre have determined to sink to 700 ft. without delay.——The structure of the Schumacher mill has been completed, and the machinery contracted for. A vein 4½ ft. wide has been cut in cross-cutting toward the McIntyre boundary at 300 ft.——At the Miracle mine, where work was started a couple of months since, four veins have been found. A shaft on one of these is now down 25 ft. Samples assay $9 gold per ton, also some silver.——The Huronian Belt company is adding to its steam plant at the North Thompson, having ordered a 125-hp. boiler. This will make a total of 225 hp. A three-compartment shaft is down nearly 200 ft.——Rich ore has been found in the shaft on the Wright property now down 40 ft. A cross-cut is being driven to determine the width of the orebody.

Cobalt activities are as follows: The Nipissing and La Rose companies have declared their usual quarterly dividends of 5 and 1% respectively.——The Columbus Cobalt is cross-cutting at the 400 ft. level to find some veins which show on the surface.——The Peterson Lake is driving on a smaltite vein found at 160 ft. It shows improvement as work progresses, some assays being 500 oz. per ton.——Active development has been resumed at the Adanac, formerly the Pan-Silver property. Cross-cutting is in progress at 200 ft. One good vein has been cut.——The Silver Queen has been leased to a Cobalt syndicate on a royalty basis.——At the Silver Leaf high-grade ore is being extracted from the 125-ft. level. A large tonnage of milling ore is ready for concentration.—— The lease held by the Glen Lake company on the old Foster mine has been extended for an additional five years, giving the company control for a total term of nine years, with a royalty of 15% on 200-oz. ore and under, and 25% of net proceeds on ore of higher grade.

Development accomplished in the Beaver mine during the quarter ended May 31 totaled 1318 ft. The main shaft is down 1000 ft. It is to be continued to the diabase and lower contact. The mill is being increased to 150-ton daily capacity. Cash on hand amounted to $79,847. The recent trouble with the power company has been settled, for the time being, and operations are practically under the old conditions.

PETROGRAD, RUSSIA

Present Condition of Gold Mining in the Empire.—Turkestan Minerals.—Manganese.—Copper Production.—Yakutsk Minerals.—Platinum.—Graphite.

For many reasons it is very difficult to discuss the present condition of gold mining in Russia. These may be stated briefly as follows: first, the gold industry extends over such immense areas as to make the collection of statistics even under normal conditions, exceedingly complicated; second, then there is the fact that the Russian idea of statistics, although in many respects remarkably meticulous, has not extended to the comprehensiveness that is required to give an accurate idea, or anything approaching thereto, of the progress of the industry as a whole; and third, the system of clandestine removal of the metal beyond the knowledge of Government control, largely contributes to doubting even the most carefully prepared figures on the industry. Statements are continually being made that the Russian gold industry is in a bad way; and it of course admits of no misunderstanding that as far as foreign concerns engaged in exploiting the Russian goldfields are concerned they have no particular reason to congratulate themselves or their shareholders. It was stated not long ago by a Russian minister, however, that although it was becoming a habit to speak of a decline in the gold production of the empire, the statement is essentially an erroneous one. He pointed out with a show of justification that its progress has been irregular, and the tendency in the case of a setback is to give the pessimists an inning until new figures, that is to say, the results of later operations, show that such setback has been due, in all probability, to exceptional circumstances. On the whole, he contends, the gold industry of Russia is making progress, although progress is slow.

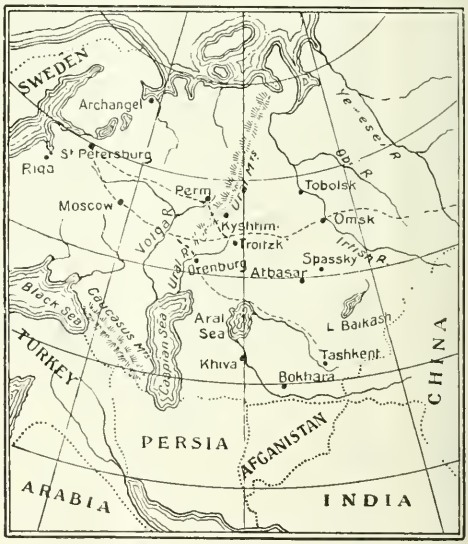
Upon this observation, the *Novoye Vremya*, the leading Russian newspaper, has studied the situation. It quotes from reliable statistics dating from the time when gold mining started in Russia, in the forties of last century, and carried down to the year 1903, during which time the industry had progressed regularly, and during several periods with considerable rapidity. During that period the production of gold in the Russian Empire rose from about 1500 to 4000 poods (700,000 to 1,867,000 oz.), per annum. These last figures are true, at all events, of the years 1900-1902. But it is clear that the irregular returns give an unfavorable impression. It was about at that time that the production of gold began to decrease rapidly. It is now as low as 1,400,000 oz., this for 1913. One may state, says the journal, with all confidence, judging from data that are available, that the decline of 1914, must have been considerable. Particulars received from the Orenburg government, Miask, Verchne-Uralsk, etc., show the decrease compared even with the relatively low one of 1913, to have been serious. The *Uralskaya-Zhisn* says, in connection with the alarming state of the gold industry, many mines have ceased producing altogether; and this is so marked that large areas that used to be desert land in the forties, and had been reclaimed from that condition owing to the development of the gold industry, have relapsed into their then desert condition, as the only value that such land had was the gold it contained. It is to be feared in view of the great disturbance to industry as a result of the War, that such a recovery as might have been expected from the infusion of foreign capital and enterprise during the next few years will not likely take effect until the country has had time to settle down, and the staple industries have recovered something of their normal capacity.

A statement issued on the gold production of Russia in 1914 shows that the quantity of gold slime received in the Treasury smelting laboratories amounted to 1,385,000 oz. against 1,283,000 in 1913, equal to 7.9%. The delivery of gold during the last four years has been irregular. It amounted in 1912 and 1913 to less than in 1911, while that of 1914 was the maximum.

The dominating position in the gold yield is held by eastern Siberia, where the quantity produced in 1914 greatly exceeded that of 1913, while on the contrary, the output in the Urals and in western Siberia fell compared with 1913. The following table shows the relative importance of the gold producing areas as recognized in the country:

	Eastern Siberia	Western Siberia	Urals	Total
	oz.	oz.	oz.	oz.
1911	1,125,000	99,600	69,600	1,294,200
1912	998,000	105,000	100,000	1,203,000
1913	1,066,000	108,000	109,000	1,283,000
1914	1,194,000	107,000	84,000	1,385,000

The fine gold content in 1914 was 1,164,000 oz. If the gold melted in private laboratories, (results from which are not available) but about equal to that obtained from similar sources in 1913, that is, about 512,000 oz. the total production of fine gold in Russia in 1914 would be 1,676,000 oz. Gold production in the Urals has fallen away considerably on account



----------RAILWAYS. ..... BOUNDARIES.

PART OF RUSSIA AND SIBERIA.

of the shortage of labor. In western Siberia the decline was chiefly in the Tomsk district. In eastern Siberia the increase was mainly in the largest gold-producing area in the Empire, namely the Bodaibo. In the Irkutsk and other districts the yield fell in one area, the Zeisk.

With this gold the following quantity of silver was obtained in Treasury laboratories: Urals, 22,000; western Siberia, 18,000; eastern Siberia, 105,000; a total of 145,000 ounces.

Lapland was often thought of as the coming gold district of Finland. Results have been as follows: In 1836 gold was first found in the valley of the River Kem, and the Government provided a large sum of money to work the mines. At Enara in 1870 there were 18 mines, employing 335 men. Yield in that year was 620 oz. Next year there were 22 mines and 491 men. The output was 1890 oz. This was the maximum yield in any one year. Since 1876 production has declined. The last annual report shows a total return of 27 oz. Thus it may be considered that Lapland gold has lost all interest. The total yield in the region amounts to 15,700 ounces.

The mineral wealth of Turkestan is frequently referred to in the Russian press, and a recent discussion of the subject in

a Petrograd paper shows that these mineral reserves have been little exploited. It is known, however, that on the main arteries of the expected future routes there is coal, large quantities of manganese ore, silver-lead ore, asbestos, graphite, turquoise of fine quality and quantity, and plenty of gold-bearing sand. The last named are found on the River Vachma. They have been but little investigated. It is of interest to note that the production of gold is made by the lower classes, people without regular employment. Methods are very primitive.

A Russian mining product of vast importance that is bound to feel the effect of the War and the exclusion of Germans from their favorite fields of enterprise in Russia, is manganese, which had so largely fallen into German hands. What effect the cessation of the export of Caucasian manganese may have had on the great German metallurgical industries will not be known for some time. It is possible, as Germany was a very large importer for some years, that considerable stocks had been accumulated. The position at Chiatur, that is the manganese field of the Caucasus, for 1914 is given as follows in the *Metallurgical Journal*: The production of manganese in 1914 amounted to 40,446,000 poods (652,354 tons). This is a reduction of 18,742,000 poods (302,290 tons) on that of 1913, or 31.67%. This reduction, it may be assumed, is principally due to the military operations in which the country is engaged. In the first six months of 1914, 40,105,000 poods (646,854 tons) was dispatched from the mines, or 9.46% more than in the corresponding period of 1913. The export of manganese ore through Poti in 1914 compared with 1913, for the first eight months of the year, showed an increase of 1,824,000 poods (29,419 tons), or 7.2%, and through Batoum an increase of 135,000 poods (2177 tons), or 0.8%. The countries to which the ore was exported during 1914 were; Germany, 326,403 tons; Belgium, 154,467; Great Britain, 107,838; United States, 34,548; Austria-Hungary, 32,435; and France, 23,951 tons. As these figures but slightly exceed the exports to the respective countries during the first half of the year, it is obvious that the military operations must be held to account for the practical stoppage of business during the second half.

One metal, at all events, the production of which is growing in Russia, except the Caucasus, is copper. During the first two months of this year the total quantity of metallic copper produced in the Urals was 2877 tons, which is 431 tons more than in the corresponding period of 1914. Obviously, this increase will be in response to the demand for military uses. For some time previously there had been an ominous decline in the output of the Russian copper fields, so that this revival must be taken as altogether exceptional, and not indicative of the tendency of the industry, although in respect to this observation it must not be forgotten that it is difficult to account, all the same, for the preceding decline in the Russian copper industry, after a number of years of remarkable and progressive prosperity.

In the third district of the Caucasus, where there has been considerable difficulty in operating copper mines owing to the military situation, last year there were five copper smelters at work, as follows: Kedabek factory in the Elisabetpol government, the quantity of copper ore produced was 14,401 tons, yielding 794 tons of copper; Sisimadansky factory in the Erivan government, 154 tons of ore; Syunikshy factory in the Elisabetpol government, 644 tons of ore and 872 tons of copper, obviously from previously accumulated ore (or other than mineral on the spot) unless the figures given for the ore are incorrect; Uruchaisky factory, in the same government, copper ore 2786 tons and metal 481 tons; and Katarsky factory in the Elisabetpol government, 2131 tons ore. The total copper smelted was 2147 tons, against 3071 tons in 1913. Besides the factories with mines named, at various other mining works in the Elisabetpol and Erivan governments, 4234 tons of ore was produced, besides a small quantity extracted in development.

According to a note in the *Siberian* Echo, an engineer, N. Bosenko, who has been investigating in the Yakutsk region, has proved in that area the following deposits of metals and minerals: gold, 27; native silver, 1; graphite, 3; silver-lead ore, 15; mercury, 1; tin ore, 1; copper ore, 7; iron ore, 50; coal, 65; rock-salt, 8; salt springs, 10; Glauber salt, 2; barite, 2; asbestos, 3; fluorspar, 1; gypsum, 2; sulphur ore, 34; asphalt, 1; petroleum, 4; amber, 7; fireclay, 6; marble, 41; and precious stones (various), 65.

At a recent meeting of the gold and platinum producers of the Urals district it was decided to urge the Government to establish a platinum-refining factory as soon as possible. This question has been before the Government and the precious-metal producers for a number of years. It has been discussed many times from every point of view, but the influence of the vested interests have hitherto been too strong for a decided step to be taken, except in the form of resolutions, many of which have been vigorous enough. But the refining laboratory so long hoped for is still the subject of much desire.

In connection with the institution of a regular steamship service between the mouths of the Yenissei and Ob rivers, by the northern sea route, the possibility of developing the graphite deposits of the Turuchany district is again to the front. These deposits have been known for a long time, but efforts to work them only started a short time ago. On the occasion of the Russo-Japanese war, permission to import certain classes of goods free of duty by the Yenissei was granted. On the initiative of two persons, several thousand tons of graphite was extracted and delivered on to the bank of the Yenissee river. Shortly after the traffic from Yenissei through the Arctic ocean was stopped and the graphite was left on the banks where it had been placed.

In point of quality the Turuchany graphite was highly esteemed. It is considered much finer than the Ceylon product. Of course there is the question of the cost of production, which is perhaps exaggerated in the minds of those who consider the question. Turuchany graphite is found on the lower Yenissei along the banks of the tributary rivers, outcropping in great beds; and thus its production does not involve expensive equipment. The extra expenditure consists only in what is paid for labor, especially in view of the difficulty of providing food for the workmen. But the high value of graphite itself, and the low sea charges, can very easily support these expenses.

A further question that arises in connection with the production of this mineral is the institution of concerns in Russia for manufacturing the graphite into goods for the market, which should be considered along with the feasibility of its conveyance from the Yenissei to such points as it may be economical to deliver it at. It is even suggested that factories for manufacturing graphite might be established in Siberia itself.

An interesting correspondence comes from the Amur area showing that rich gold-bearing ground has been discovered in the neighborhood of Gonzha station, about midway on the Amur railway. The discovery has attracted a considerable number of men who have promptly staked claims. The first position discovered has been claimed by a local official. At the same time many are engaged seeking fresh deposits.

IRON RIVER, MICHIGAN

Iron-Ore Production.—Iron River Activity.—Steel Ore-Cars.—Iron-Ore Producers.

The ore business is beginning to liven up a litle. Things have been very quiet on the iron ranges during the first half of the shipping-season, but, as has occurred before, it is now hoped that increased demand will necessitate a considerable speeding up at the mines. The more optimistic are predicting an output of 40,000,000 tons, but it is not generally believed this total will be reached. Last seasou, which was unsatisfactory, only 32,790,000 tons was sent down the lakes, compared with over 50,000,000 tons in 1913. Due to the low prices

for iron ore in 1914, which were as low as in the bad years of 1912 and 1905, considerable ore mined was put on stockpile to wait until prices advanced. This accumulation at the mines has been a detriment to active mining operations during the present season, and many properties that had employed good forces for years curtailed to the oldest and best miners.

The Breitung-Kaufman mines in the Negaunee basin, which somehow were kept operating full blast during previous periods of depressions, were among those affected by the dull times of recent months; in addition, however, to the few old miners retained at these mines, several hundred more men are now being taken on. This firm is thought to have once more made good-sized ore sales in its peculiar manner. The Iron River district took on new life several weeks ago when six of the moderate-sized companies operating there re-opened their mines. This district had not known a dull period for years, and had lately been the scene of a boom in iron-mining circles, so that the energetic population of the district is much pleased

PART OF MICHIGAN IRON RANGES.

to see work resumed. At the new Balkan mine in the Crystal Falls district, Pickands, Mather & Co. is developing a large orebody taken over from the E. J. Longyear Co., which found it by diamond-drilling. The pit has been stripped to a depth of 80 ft., around the sides of which the railroad winds in a spiral after the characteristic Mesabi Range manner; a new steel head-frame has been completed at which an ore-crusher from the old Hemlock mine will be installed, and perhaps a concrete lining will be put in the shaft where it is in sand and gravel, as considerable water comes in this upper portion above bedrock. Unless unforeseen delays occur in the stripping, it is expected to ship a fair tonnage before the season closes in November. The old Hemlock of the same company at Amasa, also near Crystal Falls, which has been such a steady shipper for many years, is worked out. The equipment is being overhauled for removing such of it as is in good condition to the new Warner mine of the same company, only a few miles away, where a moderate-sized orebody has been developed. The Lake Superior & Ishpeming railway, which is owned by the Cleveland-Cliffs Iron Co., and makes a regular business of transporting iron ore from the Marquette range to its own steel and concrete ore-dock at Marquette, has placed an order with Cambria Steel Co. for 400 fifty-ton, all-steel ore-cars to replace worn-out wooden cars, and to increase the carrying capacity of the line. The L. S. & I. besides serving the various Cleveland-Cliffs mines around Negaunee and Ishpeming, carries ore for several other mines and maintains passenger service, competing with the Duluth, South Shore & Atlantic railway. Gradually all the old wooden ore-cars on the several Iron-ore carrying railroads are being replaced by all-steel cars.

As opposed to any contention of the United States government that the Steel Corporation has any kind of a monopoly on Lake Superior iron-ore reserves, or from inference, that there is a lack of competition in the ore business, it is the growing belief and flat declaration of mining officials on the iron ranges that there is altogether too much competition. Within the last five years there have been a number of new arrivals in the ore-mining business at Lake Superior, in addition to which many of the older companies underwent expansion and acquired new holdings. To mention some of the ore-mining operators on the iron ranges, there are besides the Oliver Iron Mining Co., which is the Lake Superior mining department of the Steel Corporation with 30 or 40 great mines; the recently formed Arthur Iron Mining Co., which is the Great Northern or Hill combination of mines in Minnesota, the leases of which were recently relinquished by the Oliver company; the Longyear interests of Minneapolis, which, although a new arrival in the mining business have long been a diamond-drilling contract firm; the Cleveland-Cliffs Iron Co., with a dozen mines on the Marquette Range and two or three elsewhere; Pickands, Mather & Co. with about a dozen mines and developments scattered on the different ranges; Corrigan, McKinney & Co., the Rogers, Brown group of Buffalo; Jones & Laughlin; M. A. Hanna & Co.; and Oglebay, Norton & Co., similarly situated as Picklands, Mather & Co.; the Newport Mining Co. with its two big holdings on the Gogebic Range owned by Ferdinand Schlessinger of Milwaukee; the Republic Iron & Steel Co. with various scattered holdings; the Penn Iron Mining Co. of the Cambria Steel Co; the Loretto Iron Co.; the half dozen mines of the Breitung-Kaufman families; the Tod-Stambaugh Co.; the Inland Steel Co.; the Wickwire Steel Co.; the Davidson Ore Mining Co.; the Zimmerman mine; several locally-owned companies on the Mesabi and Cuyuna Ranges; and a few others. Of this array of mines, perhaps 150 different properties, some only serve to supply ore to their controlling iron or steel companies, such as the Steel Corporation, Jones & Laughlin, etc., but most of the operators sell ore in the open market, and have a more or less regular business, as have the Cleveland-Cliffs Iron Co. or Oglebay, Norton & Co. Due to the activity of some of the newer concerns such as the Breitung-Kaufman companies, or the Great Northern interests, prices have been much cut in late years until several of the old operators claim there is no more profit in the business. Thus during periods of low prices, Jones & Laughlin sometimes curtail production from their own mines, and buy a good portion of their ore in the open market, for the reason that they say they can obtain it cheaply in that manner.

GOLDFIELD, NEVADA

Tests are being conducted on a large scale at the Goldfield Consolidated mill to devise a process to treat the low-grade refractory ores of the district. The equipment for these tests is said to have involved a considerable expenditure, but certain results have been guaranteed. The process involves concentration and oil-flotation, but it is said that it cannot in any way conflict with existing patents of established flotation processes. It has already been shown that $9 ore can be profitably treated, in comparatively small quantities. This value will be reduced in handling a large tonnage. The problem is of vital importance to Goldfield, as there are large quantities of copper-gold ore worth from $6 to $12 per ton in the Atlanta, Mohawk, Red Top, Laguna, and other mines.

A report on the Silver Crown (Stimler) district will be published in the PRESS next week.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

In Professional Paper 87 of the Survey, Charles Will Wright describes the geology and ore deposits of Copper mountain and Kasaan peninsula. This publication covers 110 pages. These are two important copper-bearing areas in southeastern Alaska. The first is a peninsula projecting into Clarence strait from the east side of Prince of Wales island, and the second is a small area which encircles the base of Copper mountain, on the west side of the island, easily accessible to ocean traffic by the upper part of Hetta inlet. Both districts are within the Ketchikan precinct, this town being the recording office.

Juneau

The repaired Central hoist, resumed work on July 13. The break occurred on June 19. The '300' mill lost 10 days, '240' about 24 days, and the '700' and Mexican mills about 21 days each. While stopped they were thoroughly overhauled. At the Ready Bullion mill a concrete foundation is being laid for another 30 stamps. This will make a total of 180 stamps.

According to Charles Hayden, president of the Alaska Gold Mines Co., who has recently been to Juneau, the property is in excellent condition. Cost estimates have been lowered. In June the mill treated 90,790 tons of ore. The daily tonnage will soon be over 5000. During the latter part of August No. 3 unit should be in operation. By September the plant will treat 7500 tons per day. Dividends are possible by July, 1916.

ARIZONA

Producing mines in this state have been valued for taxation purposes at $121,225,834, an increase of $11,000,000. In 1914 they were valued under a specified law, the basis of which was four times net production, plus 1½% of the gross and physical value of the improvement this year. The commissioners fixed the values under the general statute, taking into consideration the earning capacity for the last three years, the selling value of the stock and other matters. The county values are as follows in descending order: Cochise, Gila, Greenlee, Pinal, Yavapai, Mohave, Santa Cruz, and Maricopa. The Copper Queen, in Cochise, leads with a total valuation of $29,357,657.

Cochise County

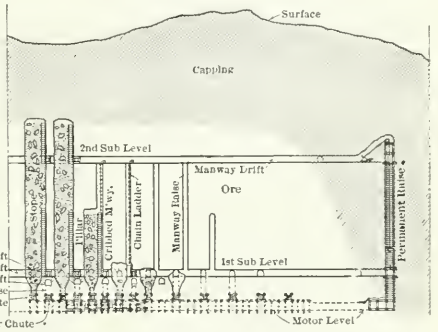
An average of 400 tons of copper, 100 tons of lead, and 100 tons of silicious gold-silver ores is being extracted each day from the Shattuck-Arizona. The lead ore goes to El Paso, the remainder to the C. & A. smelter at Douglas. Over 200,000 tons of $15 gold-silver ore is ready for extraction. Between 300 and 600 ft. is a large quantity of lead ore. A drift at 100 ft. is in 170 ft. in ore averaging 10% copper.

Gila County

The Inspiration Needles company, formed in 1912, controls ground west of the Inspiration and Miami. Shares are now to be sold to obtain money for drilling. Roads are also wanted, four miles having been constructed at $1000 per mile by the company. D. R. Williamson is president.——Mining men in the Gibson district are pleased on account of the county supervisors calling a bond election to re-construct roads, and make new ones into the mining areas.——The Superior & Boston company is to prospect below 800 ft. Sulphide ore found in the lowest level is similar to that at 1300 and 1400 ft. in the Arizona Commercial. Between 600 and 800 ft. in the S. & B. over $600,000 of ore has been extracted from one stope.——Magma Copper Co. shares are being traded in on the New York Curb. They are quoted at about $13. Net earnings in 1915 are estimated to be $750,000, July being $100,000. When the three-compartment shaft is finished in October, full capacity will be attained. Ore reserves in February were estimated at 95,000 tons of 7.6% copper, 8.16 oz. silver, and 56c. gold ore.

Pinal County

Three weeks ago a strike of Mexican miners started at the



CROSS-SECTION, RAY MINE, SHOWING SHRINKAGE STOPES AND PILLARS.

Ray mine. They have returned to work, and will be paid on a sliding scale according to the price of copper.

Yavapai County

Effective July 1, and as long as copper averages 18c. per lb., wages at the United Verde were increased, and will remain so, 25c. per shift.——At the Edith shaft of the United Verde Extension a Nordberg electric hoist, with 250-hp. motor, is to be installed. Underground work is confined to the 1100 and 1400-ft. levels. Regular ore shipments are made to Douglas. When the tramway to the V. T. & S. line is completed, consignments will be made to the Clarkdale smelter. D. Kingdon is in charge pro tem.

CALIFORNIA

Amador County

The Plymouth Consolidated makes the following preliminary report for June: ore treated, 11,000 tons; gold yield, $54,780; operating expenses, $29,940; development charge, $2349; and surplus, $22,491.

Eldorado County

Manhattan, Nevada people, headed by J. McGee, have acquired the property of M. B. Ryan at Frenchtown. A 100-ton crusher is to be erected.——According to B. Evans in the *Placerville Republican*, the Inez-Central or Hearst's mine, one mile north of Amador county, and on the Mother Lode, has a good past record but has been allowed to remain idle for over 30 years. It is full of water and has caved in places, but deserves the attention of companies looking for properties.

Kern County

The Atolia tungsten district is busy. The Atolia company's new mill is nearing completion. Other installations are being put in. Lessees are doing well. The power-line from Randsburg is being extended to Atolia.

At Randsburg the Sunshine mill recovered $3000 from ore from 525 ft. depth.——Seven and a half tons from the Black Hawk, owned by D. A. Blue, yielded $2274. This came from

125 ft. Over 6,000,000 cu. yd. of placer ground is included in this property.

At Woody, the Weringer mine has been opened to 170 ft., and according to A. P. Peake of Butte, Montana, who recently acquired an interest in it, there is probably 100,000 tons of copper sulphide ore in the property. The ore opened averages 4 to 5% metal. Equipment of 500-ft. depth capacity is to be installed.

NEVADA COUNTY

At the Le Duc Mining Co.'s property, between the Empire and Union Hill mines, controlled by Grass Valley and San Francisco people, with B. A. Penhall in charge, four veins have been opened with encouraging prospects. A lava over-burden has made prospecting slow and expensive.

SHASTA COUNTY

(Special Correspondence.)—Considerable prospecting is going on near Heroult, endeavoring to develop a good supply of manganese ore for the smelter. Some good ore has been found. The Noble Electric Steel Co. has applied to the Railroad Commission for permission to lease the Sacramento Valley & Eastern railroad until December 31, 1918. The line extends from Pit, on the Southern Pacific, to Winthrop, near the Bully Hill mines.

Redding, July 18.

SIERRA COUNTY

On July 17 bandits held up the millman and watchman at the Plumbago mine, scraped $3000 of amalgam from the plates and escaped. On July 4 the superintendent, W. B. Pearson, and his foreman, M. McCullough, were robbed.

SISKIYOU COUNTY

(Special Correspondence.)—An auto trip through a good part of this county leaves the impression that, save a few properties, there is little of importance. Farmers are doing well. The El Oro dredge near Yreka is making a satisfactory recovery, as is the boat eight miles away. There are several likely gravel areas that might pay to dredge. The El Oro company is prospecting on Indian creek. A copper mine, being developed by Anderson and others, is shipping 12% ore to the Mammoth smelter. Prospects are good. Freight and treatment costs $13 per ton. The ore yields $40 per ton.

Yreka, July 16.

Good progress is made in erecting the mill at the Victory company's mine at Etna mills.——A good development is reported from the Cub Bear.——Sacramento people have bonded the Miller mine at Indian creek.——A dredge is to be started at Oak Bar on the Klamath river.

SONOMA COUNTY

(Special Correspondence.)—The Culver-Baer quicksilver property of eight claims, and the whole area of 2800 acres, has been acquired by Walker Smith. Mrs. Ida Davis of Angels held an option on the mine. The transaction amounts to $100,000. Ten men are employed, more are to be added. Machinery for large-scale operations is being ordered. Some work has been done each summer in recent years. The mine has had a good past record, but was closed from 1879 to 1901. Cloverdale on the Northwestern Pacific line is the nearest town.

Cloverdale, July 20.

TUOLUMNE COUNTY

During the past 10 months seven sets of lessees (35 men) at the Jumper mine, near Stent, extracted gold worth about $10,000 per month. Only four sets of men made wages or over. A royalty of 25% is paid also $1 per ton for crushing ore.

COLORADO

LAKE COUNTY (LEADVILLE)

Station cutting proceeds at the Penrose pumping shaft. A stoppage of a few hours of one pump, the other working, allows the water to rise quickly, showing the large area to be drained. ——The zinc oxide plant is producing 150 tons of product per month. It contains 70 to 80% zinc, and realizes $100 per ton. Small mines find a profitable market here for their low-grade carbonate ore.——Six cars of over $100 gold ore has been shipped from the Lackawanna Belle. As the snow was late in melting in the Lackawanna district, mining is about four weeks behind.——A large tonnage of carbonate is being shipped from the Hayden shaft on Fryer hill.——In June the Ibex company produced more ore than in any month for five years. The C. & G. lease at the Ibex is mining 200 tons per day.—— The Fortune mine in Big Evan gulch is being re-opened in charge of J. McNeece.

IDAHO

CLEARWATER COUNTY

Transport facilities have retarded development in the county, but ore from several properties is now being sent to smelters at Tacoma and Butte by parcel post. The distance from Stites on the Northern Pacific line to Dixie and other centres is 75 miles by stage. About two tons of ore and concentrate is carried daily at $1.05 per 100 lb. to the smelters. The stage contractors receive 2c. per pound from the post-office, so that the Government is losing money. A highway to cost $100,000 is suggested for the Government. This would aid miners and farmers, and save money for the authorities. The Clearwater districts are busier than ever, according to J. T. Omo. At the South Fork mine at Ten-Mile, Mr. Omo and others have opened a good deal of ore. About $100,000 has been recovered by a 5-stamp mill. A power-plant and 25 stamps are contemplated, costing $25,000. The Buckhorn nearby, has 10 stamps crushing $20 ore. Good profits are being made from a small mill at the Center Star.

CUSTER COUNTY

The Lost Packer mine is working at full capacity, producing 300 tons of high-grade copper ore per day. This is sent to Garfield, Utah. In June 169 railroad cars of ore was shipped. A 50-ton flotation plant is being erected to treat the lower-grade ore. The local smelter is soon to be started. P. J. Boyle is superintendent.

The Lost Packer mine is at an altitude of 5600 ft. It is 110 miles from Mackay on the Oregon Short line. Two high peaks have to be crossed to reach the property. Coke costs $46 per ton. Haulage charges are 2½c. per lb., round trip. Water power is available. The vein is from 6 to 60 in. wide. It is a fissure in mica-schist, dipping 70° west, with a north-south strike. Flat dikes of porphyry and granite-porphyry, 5 to 60 ft. wide, cross the vein. The ore averages 4.5% copper, 0.5 oz. gold, and 26% iron. Ten adits and other underground work total 14,000 ft. A 100-ton hot-blast pyritic smelter has yielded gold worth $300,000, and $150,000 copper, in three campaigns, work being only possible in summer. Ore sent to Salt Lake City totals $50,000. The expense charged against one ton of ore delivered as matte at Mackay is $22. This is the most isolated smelter in the United States.

IDAHO COUNTY

Three mines in the Orogrande district are shipping six tons of ore per month by parcel post.——At Elk City the Mineral Zone and other mines are working. The dredge has been acquired by new people.——Washington, D. C. men have bought the Idaho Champion mill at Dixie. They are putting in 10 new stamps and other plant.

OKANOGAN COUNTY

Near Nighthawk the Caaba mine has been bonded for $40,000 for three years to H. W. Newton, formerly of Republic, and D. H. Jones of Spokane. The present output is 45 tons per day. This to be increased to 75 tons. The Nighthawk 20-stamp mill has been leased.

SHOSHONE COUNTY (COEUR D'ALENE)

The Interstate-Callahan company is to spend $25,000 on improvements. These will include a 200-men dry-house, 20 three-room cottages, 70-room addition to the bunk-house, and in-

creased boarding-house capacity. Shares of this company are now quoted around $20. Before the rise in zinc they were about $4.

The Mining Men's Club of Spokane is to get 200 to 250 representative men to visit the chief points of interest in the Coeur d'Alene about August 15.——It is reported that the Day interests have secured control of the Northport smelter, and that the Hercules mine is to be re-opened. Improvements cost-

INCLINE TRAM, 2½ MILES LONG, FROM STEWART MINE TO LOADING-STATION ON RAILROAD, WHENCE ORE IS HAULED TO THE MILL AT WALLACE, ABOUT 16 MILES.

ing $50,000 are to be made at the mine at Burke.——Helena people have secured a 60-day option on the Idora mine and mill on Sunset peak for $150,000.——The National Copper Co. is examining the Missoula copper mine for the purpose of buying it. The National shaft is being sunk.——A large shoot of copper ore has been opened in the Reindeer-Queen.——The H. E. M. company has purchased plant worth $10,000. The 100-ton mill will be ready in September. Development and plant will have cost $90,000 by then.

MICHIGAN

At the new Isle Royale mill the second stamp started last week. A third will be ready in a few weeks. The daily tonnage is now 1200.——The New Arcadian shaft is down nearly 1000 ft.——About 10 drills are working in the South Lake. Ore is to be sent to the Franklin mill.——At the Franklin 18 drills are working, mostly in Allouez conglomerate. When the electric haulage plant is installed, shipments will be from 1000 to 1200 tons per day.——The North Lake shaft is being sunk to 800 ft. at the rate of 50 ft. per month.——The Hancock has 30 machines at work, but the output is only 300 tons daily.——Prominent copper men have been visiting the White Pine district.

MISSOURI

Jasper County

Calculating that the Joplin district production was reduced by 4000 tons per week owing to the strike, the value being $385,000, the cost of this would be $200,000, of which labor would get $102,000. So the men were losers by this amount. All mines are again operating. The attempt at unionizing the men apparently failed.

Production of the Missouri-Kansas-Oklahoma district last week was 2502 tons blende, 175 tons calamine, and 662 tons lead, averaging $96.04, $53.54, and $59.79 per ton respectively. The total value was $289,170.

It is reported that a 700-ton mill is to be erected by the U. S. Smelting company at the Ravenswood lease of the Cornell land, three miles southwest of Sarcoxie. The greatest speed will be made in construction.

At the Missouri Lead & Zinc Co.'s land a 10-in 4-stage Texas pump has unwatered a number of shafts to 95 ft. depth. Many men are applying for leases at the drained area.

A 300-ton mill is to be constructed by W. Squires on a lease of the Cosgrove land, Duenweg.

A thorough geological investigation has been made of the Saginaw Mining & Leasing Co.'s lease of 746 acres of the Saginaw Investment Co.'s land at Saginaw. The object was to see whether they would buy the lease for $150,000. Good developments have been made.——A 150-ton mill is being erected on the Bert Flournoy land, near Aurora. Ore is found at 90 ft., continuing to 160 feet.

MONTANA

Cascade County

The Queen and Galt companies' properties at Neihart are being examined by C. J. Kelley and Reno H. Sales for the Anaconda company. The mines produce low-grade lead-silver-zinc ore. Treatment has been a difficulty, but flotation is expected to solve the problem.

Lewis and Clark County

A comprehensive map, 42 by 62 in., of the mining districts tributary to Helena, has been prepared by The Engineering Corporation of Helena. With it is a printed index of 32 pages giving the number of each claim, location by section and township, and name of present owners together with their post-office address. The price is $5 and $6 respectively for the two styles of maps with index. A great revival of mining is taking place in the district, which has produced a great deal of gold, silver, and lead. Zinc ore also occurs in commercial quantities.

Silverbow County

The county assessor values property of all descriptions at $39,516,795, plus $3,000,000 for railroads.

The Butte & Milwaukee property, controlled by the Butte & Superior company, is to be developed. By a cross-cut from the Black Rock claim, it has been opened to 1200 ft. A new hoist will be ordered for the Colonel Sellers shaft. In the Black Rock a station is being cut at 1700 ft. The shaft is progressing at 75 ft. per month. It is in zinc ore and is hard to break. The daily tonnage has been somewhat lower than in April, 1300 to 1400 against 1700 tons.

NEVADA

Esmeralda County

Thirty miles northwest of Millers is the Orizaba mine in charge of L. L. Patrick, from which 30 tons of ore is to be shipped. Past shipments totaled $50,000. Development is encouraging, and a mill is contemplated. The Diamondfield Black Butte Reorganized Mining Co. of Goldfield, controls the property.

F. A. Wheeler and C. W. Watson, lessees at the Cottonwood Canyon Mines Co.'s property at Silver Crows, formerly Stimler, 50 miles west of Goldfield, state that a mill may be erected after a suitable process is devised.

At the meeting of the Jumbo Extension company at Phoenix, Arizona, on July 19, Charles S. Sprague was elected president and general manager. This is a vindication of his past work, over which there was considerable controversy.

Nye County

Five companies and lessees at Tonopah last week produced 10,307 tons of ore worth $211,486.——Some June outputs are as follows:

Mine.	Tons.	Bullion.	Profit.
Belmont	14,693	267,830	$84,234
Jim Butler	4,680	.....	34,777
Tonopah	12,170	248,525	83,635

In the Extension new stopes are being opened at 1260 ft. The stope at 1170 ft. is 20 ft. wide, against 35 ft. previously.

——The Midway shaft is down 1300 ft. Lessees are opening new ore of good grade.——The diamond-drill at the Umatilla is down 1390 ft.——The West End mill treated 1071 tons last week.

STOREY COUNTY

Rapid progress is being made in the mines at the north end of the Comstock, according to W. W. Turney of San Francisco. At 2700 ft. and other points, work is nearing the time when the ventilation and drainage will allow prospecting to proceed to advantage. In the Ophir a good quartz lode has been followed from 1800 to 2500 ft. Work under way in the Mexican, Union, and Sierra Nevada is of great importance. In the first named, output last week was 135 tons of $8.36 ore, the Patton cross-cut has opened a vein at 2500 ft., west of the stope between that level and 2300 ft. which yielded nearly $1,000,000. In the Union at one point there is 9 ft. of quartz assaying up to $40 per ton. It is estimated that the east and Comstock veins will junction at 2700 ft. In the Central drift the Ophir continues to get favorable results. At 2700 ft. the Pumping Association is repairing the south drift from the Union-Mexican winze.

WHITE PINE COUNTY

The Princess Copper Co., composed of Salt Lake City men, is to start work at its property near the Nevada Consolidated. Some development has already been done, and ore shipped. C. W. Freed is president.

NEW MEXICO

In Bulletin 1 of the New Mexico School of Mines at Socorro, the mineral resources of this state are discussed by Fayette A. Jones, director of the institution. With a map it covers 77 pages. A catalogue of minerals gives 224 names, and the districts in which they occur. The mineral production of the state is expected to be $20,000,000 during 1915. The industry rivals the combined industries of cattle, sheep, agriculture, and horticulture. The mines of New Mexico employ more men than any other single industry, save farming. A historical summary of mining in the state is given, followed by general geology and distribution of minerals by districts and counties. The publication is a valuable résumé of the present situation of the industry in New Mexico.

LINCOLN COUNTY

At White Oaks last week the Wild Cat company's Wilson, Old Abe, Harrison, and Homestake gold mines were acquired by a company including W. M. McDonald, T. N. Stanton, and R. Wightman.

The Old Abe has produced over $1,000,000 to 1500 ft. depth, and the Homestake a large amount from 1000 to 1400 ft. A good deal of ore exists in the latter.

LUNA COUNTY

Los Angeles, California, and other men have bought the Grand Central mine in the Lake Valley district. This is a zinc-lead property. Enough ore has been opened to justify a 300-ton mill.

SOCORRO COUNTY

The Mogollon district is prosperous.——Good ore has been opened in the Pacific mine.——A dividend amounting to $50,000 is to be paid by the Socorro Mines Co., the first for 2½ years.——The Ernestine company has paid 2%, the first for two years. This company has been spending a good deal on development and equipment.

SOUTH DAKOTA

In the Palace of Agriculture at the Panama-Pacific Exposition the mines of this state are represented by three cases of specimens and pamphlets. The Black Hills region is essentially a gold producer, 95% of over $7,500,000 mineral production in a year being gold. The silver yield is about 100,000 oz., and sand and gravel over 1,000,000 tons. The exhibits include samples of gold ore from the Homestake, Wasp No. 2, Golden Reward, Hidden Fortune, Heidelberg, Treasure, Imperial, Ragged Top, Phoenix, Echo, Hidden Treasure, Bismarck, Two John, and Hailstorm. There are also displayed spodumene, cassiterite, Nigger Hill tin, sandstone, limestone, and sand-lime brick.

LAWRENCE COUNTY

The North Homestake mine, in the Maitland district, is to be re-opened. During a long shut-down an electric pump kept water at 200 ft. The shaft is to be unwatered.——Work has been resumed at the Hidden Treasure's 200-ft. level. The hoist, etc., was overhauled.——The Monarch has been leased, and pumping is under way.——The Homestake Extension is to be sampled as soon as the shaft is unwatered.

PENNINGTON COUNTY

According to C. H. Kamman, his company's Cowboy mine near Hill City contains tin worth over $40,000. The Mohawk mine will supply the 25 to 50-ton mill to be erected. This will be constructed mostly from the old Harney Peak tin mill.——The tin plant west of Hill City is busy, and tin bars are reduced from the concentrate.

TEXAS

EL PASO COUNTY

The A. S. & R. smelter at El Paso is receiving more ore than it can handle, so some contracts are being treated at the smelter at Hayden, Arizona.

UTAH

JUAB COUNTY

On July 16 the Iron Blossom company paid 5c. per share. The quarterly dividend is to be reduced to this amount, equal to $50,000, from the usual 10c., or $100,000. Present earnings will allow of the old rate before long.——On August 2 the Chief Consolidated will pay a 5% dividend.

An old tailing dump of 4000 to 5000 tons at the McIntyre ranch, southwest of Silver City, is to be shipped to the Garfield smelter.

SALT LAKE COUNTY

According to Charles Hayden, the Utah Copper Co. is operating now at full capacity for the first time. This means that it is in position to take full advantage of the present price of copper, and consequently is making large profits. Never before have operating conditions been so favorable for the property. Hitherto any increase in milling capacity would have been based upon the ability to increase the rapidity of stripping, but the stripping is now so far advanced that the mine can increase tonnage as rapidly as any increase in milling capacity can ever be constructed. Some idea of what the mine is doing may be gained from the statement that one day last week 28,000 tons of ore was treated in mills whose capacity was originally figured at 21,000 tons per day. It is thought that 30,000 tons per day is a possibility.

The Little Cottonwood district companies are very busy. Good developments may be expected.——In the Alta Consolidated about 8 in. of high-grade ore is being opened.——In the Columbus Extension the southwest drift is in softer limestone well mineralized.——At the Emma copper mine 4 to 6 in. of carbonate ore has been cut. Five to seven feet of silver-lead ore has since been cut.——At the quartzite-limestone contact in the Sells, 8 in. of good sulphide ore is being driven on.——The Wasatch continues to ship ore.——The Cardiff company reports $109,576 cash and ore sold on July 1.

At Big Cottonwood, the Alta Tunnel company's adit is in 1313 ft. More water has been encountered. Engineers of Salt Lake City have examined the property with the idea of using the water, estimating from 1,300,000 to 1,900,000 gal. per day.

SUMMIT COUNTY

Plans for a 500-ton mill, employing tables and oil flotation, to treat the dump of about 400,000 tons of zinc-lead-silver tailing acquired from the Grasselli Chemical Co., by the

Broadwater Mills Co. at Park City, are being prepared by Kirk & Leavell of Salt Lake City.——The 250-ton mill to treat 800,000 tons of tailing at Atkinson, seven miles north of Park City, started on July 16. Kirk & Leavell also planned this, for the Big Four Exploration company.

WASHINGTON COUNTY

Several mining men predict that Goldstrike promises to be an important producer. Results at the Goldstrike Con., Bonanza, Primers, La Vors, Bnll Valley, and Hassayampa are decidedly good. In the first named 30 in. of rich ore is being opened.

WEBER COUNTY

Abont 200 men are to be employed at the Promontory Point zinc mine, controlled by the Lakeview Mining Co., Lorenzo Farr, president. The company has leased its Carbonate Hill ground and No. 1 claim, at a royalty of $9 per ton shipped. Shipments have been made for some time. Auto-trncks are to be used to haul ore to Saline, three miles.

CANADA

BRITISH COLUMBIA

A smelting contract for zinc ore from the Lucky Jim mine at Zincton has been arranged with the Granby Mining & Smelting Co., at Neodesha, Kansas. Crude ore will be shipped first, concentrate from the Ivanhoe mill at Sandon later on. ——The Slocan Star mine and mill is employing 65 men. The vein was recently cut at 900 ft. Development is to start at 1000 ft. The daily output of the mill is 14 tons of zinc and 4 tons of lead concentrate.——The Surprise mine is shipping 300 tons of zinc concentrate, and some ore, to the Empire Zinc Co., New Jersey.——At the Rambler-Cariboo are 50 to 60 men. Lead concentrate is sent to the Trail smelter. Zinc product is being stored until a new contract is made.——At the Cork mine, between Kaslo and Zincton, 35 to 40 men are mining lead ore.——A good profit is made at the Utica with over 30 men.——In the Noble Five adit, a vein was cut at a depth of more than 1500 ft.——Fifty men are to be employed at the Ruth at Sandon.——Oil flotation at the Hewitt, Silverton, is producing zinc and lead concentrates. About 500 men are working.

ONTARIO

The June report of the Nipissing includes the following information: high-grade mill treated 180 tons; low-grade mill, 7670 tons; total net production, $186,791; and refinery shipments, company and custom, 764,559 oz. Two machines drilled surface veins exposed by hydraulic prospecting. Several produced some low-grade mill ore. Best results were obtained in the Keewatin formation. The best was 50 ft. long, 1 to 2 in. wide, assaying 2000 oz. per ton. The hydraulic plant is operating on conglomerate and slate formation. On No. 4 level, snaft 73, two branch veins opened well. One is 2 in. wide, assaying 2000 oz. Other interesting development was done.

During June the Dome mill treated 27,200 tons of ore averaging $4.45 per ton, a record.

The Alexo nickel mine shipped 989 tons of ore to the smelter at Coniston in June.

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following for June, at the Suan mill:

Ore treated, tons	6,350
Mill operating, days	27.2
Bullion recovered	$42,300
Concentrates	26,500
Total	$68,800
Operating expense	$27,500
Net earnings	$41,300

Construction of the new 400-ton capacity mill at the Tul Mi Chung mine on the concession is progressing satisfactorily. It will commence operating in August.

PERSONAL

JOHN B. FARISH is here.

R. A. F. PENROSE is at Denver.

GEORGE E. FARISH is in New Mexico.

H. C. BELLINGER is going again to Chile.

HAROLD A. LINKE is visiting the Exposition.

J. DAWSON HAWKINS is here from Colorado Springs.

R. A. KINZIE was at Salt Lake City during the week.

H. VINCENT WALLACE has left Mexico and is now in New York.

E. P. MATHEWSON is expected in San Francisco on September 14.

THORVALD J. ANDERSON has returned to Boston from Valdez, Alaska.

F. LYNWOOD GARRISON is going to Arizona and will come later to San Francisco.

J. S. DILLER is at Drakesbad, Plumas county, studying the eruption of Mt. Lassen.

H. L. SULMAN has been elected president of the Mining & Metallurgical Clnb, in London.

C. J. KELLEY and RENO H. SALES are examining mines at Neihart for the Anaconda company.

H. R. PLATE passed through San Francisco on his return from British Columbia to New York.

WILLIAM B. PHILLIPS, of Austin, Texas, has been selected as president of the Colorado School of Mines.

GILBERT L. GUTHRIE, of the Butters company, was here from Russia and has returned to Atchison, Kansas.

ARTHUR C. TERRILL has been appointed head of the department of mining engineering in the University of Kansas.

E. C. TEMPLETON sailed on July 17 for Yokohama on his way to Siberia, to serve as geologist to the Ridder mine, in the Altai.

F. L. BOSQUI, in migrating from Johannesburg to London, has not resigned his appointment as consulting metallurgist to the Rand Mines, Ltd.

G. S. ROGERS, of the U. S. Geological Survey, is expected shortly to continue investigations in the water and oil problems of the San Joaquin valley.

H. M. DRAKE, son of Francis Drake, has been killed fighting as a second lieutenant with the British army in northern France. He had served previonsly in the Boer war.

Schools and Societies

The CANADIAN MINING INSTITUTE opened its meeting at Rossland, B. C., on July 15. Many well-known men attended.

The business sessions of the snmmer meetings of the GEOLOGICAL SOCIETY OF AMERICA are to be held as planned at the University of California and Leland Stanford, Jr., University, August 3-5, 1915, in affiliation with the American Association for the advancement of Science.

The AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will commence a meeting at San Francisco on August 2. This will be the first meeting of this organization west of the Rocky Mountains. The society has over 9000 members, representing all fields of scientific research. Over 20 other societies organized in various branches of science will also convene at the same time, or will participate in joint meetings during the week. The branches of science included in the series of meetings are: astronomy, mathematics, physics, geology, palaeontology, seismology, zoology, genetics, botany, psychology, anthropology, archaeology, education, and agriculture.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, July 22.

Antimony	35 —35¾
Electrolytic copper	20½—20¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$95
Spelter	24 —24¼
Tin	39 —40½
Zinc-dust, 100-kg. zinc-lined cases	38

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, July 22.—The copper market is lifeless; in lead, re-sale lots are active; spelter is quiet.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
July 15	19.25	June 9	19.39
" 16	19 12	" 16	20.12
" 17	19.00	" 23	20.00
" 18 Sunday		" 30	20.00
" 19	19.00	July 7	19.75
" 20	19.00	" 14	19.50
" 21	18.87	" 21	19.04

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended July 3 totaled 10,579,720 lb., valued at $1,900,142. France took 3,265,477; England and Scotland, 3,373,410; Italy, 1,608,046; Russia, 1,120,381; Sweden, 672,727; Holland, 287,772; and Spain, 237,355 lb. Imports of all kinds amounted to 6,333,249 lb., worth $743,759. Chile sent 2,581,331; Peru, 1,860,311; and Canada, 1,826,194 pounds.

Stocks in Europe and afloat thereto from Chile and Australia on June 30 totaled 38,041 tons

The Amalgamated Copper Co. has declared a dividend of $1 per share, an increase of 50c. Arrangements have been made for the distribution of the company's assets. This will commence on August 30. Each holder of Amalgamated will receive share for share in the new Anaconda stock, par value $50, representing two shares of old Anaconda. Also a cash distribution which is estimated at about $3 per share.

Braden, Chile, produced 2,542,000 lb. in June. This was from 91,000 tons of 2.1% ore, with a recovery of 77.21%. The estimated cost is 8½c. per lb. The half-year's total is 15,238,000, an increase of 2,787,000 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
July 15	47.50	June 9	49.35
" 16	47.62	" 16	49.31
" 17	47.50	" 23	48.97
" 18 Sunday		" 30	48.10
" 19	47.50	July 7	48.10
" 20	47.37	" 14	47.56
" 21	47.37	" 21	47.47

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57 58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec	49.27	....

Notwithstanding an occasional burst into activity, the market has subsided into a condition of inertia, from which there is just now nothing in sight to suggest an improvement. Both India and China seem to be waiting on each other to determine at what figure to intervene, and this indecision naturally is against the interests of sellers. It might have been conjectured that the recent fall in price was in consequence of the large arrival of Mexican silver in London by a United States steamer at the end of June. Such an assumption, however, is incorrect, for, by a circumstance fortunate for the seller, a special demand, unconnected with India or China, happened to arrive exactly at the time of realization, and the bulk of this abnormal supply was absorbed without any pressure upon the market at all, according to Samuel Montagu & Co. The state of affairs in Mexico precludes the idea that further Mexican supplies can be anticipated for some time to come. On July 9 about 350,000 oz. left San Francisco for China. The Beaver company, Cobalt, reports a stock of about 360,000 ounces.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June 23	95.00	July 7	95.00
" 30	95.00	" 14	95.00
		" 21	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60 00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	53.00	....
June	38 60	90.00	Dec.	53.10	....

Quicksilver in London is quoted at £15 10s. per flask, equal to $74 40.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July 15	5.62	June 9	5 44
" 16	5 62	" 16	6.66
" 17	5.60	" 23	5.82
" 18 Sunday		" 30	5.55
" 19	5.55	July 7	5.75
" 20	5.55	" 14	5.71
" 21	5.55	" 21	5.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
July 15	21.00	June 9	26.17
" 16	20.75	" 16	22.83
" 17	20.25	" 23	18.71
" 18 Sunday		" 30	20 58
" 19	20.00	July 7	22.10
" 20	20.00	" 14	22.26
" 21	20.00	" 21	20.33

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

Zinc-ore buyers in Utah are now bidding for carbonate ore as low as 30% metal.

Zinc mines in New Jersey in 1914 produced 148,506,500 lb. from 529,443 tons of ore. This was an increase of about 4,200,000 pounds.

The Interstate-Callahan zinc mine will pay $2 per share, $920,000, on August 10. This makes $1,160,000 for the year.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	....
Feb.	39 76	37.23	Aug	30.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48 25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On July 22 tin was firm at 36.75 to 37.25c. per pound.

Eastern Metal Market

New York, July 16.

The entire market in metals has been dull and uninteresting since the last report. Meanwhile the consumption for war purposes is going on at full tilt, and new factories are preparing for the manufacture of munitions. The activity of New England, the centre of the metal-working industry, is actually feverish, and the only fly in the ointment is labor trouble. This is not yet serious, but the indications are threatening at Bridgeport, Connecticut. In that city it is stated that the big work in the munition line at present is supplying the brass cases, one of which goes with each shrapnel shell. It is understood that the American Can Co. has taken a contract running into the millions for work of this character.

The steel business continues to flourish, as evidenced by the fact that the U. S. Steel Corporation's unfilled orders increased 413,000 tons in June. The Corporation is now working about 90% of its ingot capacity. It is buying large tonnages of billets from independent mills, and activity to the end of the year seems assured. Additional furnaces for making iron and steel have been started both East and West. Advances in iron and steel quotations are general. High-speed steel, now in much demand, is scarce and going to unheard of levels because of the scarcity of tungsten and chromium, both of which are supplied chiefly by foreign makers.

COPPER

Continued dullness has brought out concessions in prices, especially on the part of second-hands, although an easier tendency on the part of producers has developed also. Producers would consider offers of less than 20c., 30 days, delivered, for electrolytic. Second-hands offered the metal July 13 at 19.50c., and probably would have taken less. On July 15 sales were made at 19.12½ to 19.25c. full terms. The exact level of the market is difficult to place; in fact, there may be said to be no exact level in the absence of important transactions. On no side does there appear to be any disposition to take much copper. High-grade Lake has softened a little and 22c. is quoted, although a Bridgeport shell-manufacturer complains of the difficulty he encounters in getting it. An old New Haven manufacturer of hardware says that for the first time in his experience he has advanced the prices of his products in the face of a dull market for this material. Incidentally he remarked that with metal-prices where they are, he buys no further ahead than is absolutely necessary. Though prices are easier, the makers of brass and copper products, such as rods, sheets, tubes, wire, etc., are not issuing list-prices and all quotations are subject to immediate acceptance. The demand for brass, and its consumption in New England, continues on an enormous scale, which is to be expected with the ammunition plants working night and day. Members of the trade point out that great as consumption may be, halts in buying raw material are to be expected. Deliveries against contracts are good. A curious circumstance is related by a manufacturer of rolled-sheet copper and certain products. Apparently as a result of the prohibition wave that is sweeping over sections of the country he has not received, for months, even one order for brewers' kettles. Until lately they were a source of lucrative business. It happens, however, that the loss of this business has been more than balanced by an excellent demand from new sugar-plants in Cuba, while locomotive fire-box plates have been in excellent demand, largely for export. The circumstance, while not of great importance, illustrates how the alignments of trade adjust themselves. The exports this month (to July 17) total only 6288 tons. In the first 6 months of this year the exports were 136,527 tons, against 219,494 tons in the same period last year.

LEAD

The market has weakened and has shown much uncertainty. Certain dealers are of the opinion that higher prices may be looked for soon, and have shown their faith by buying lots at figures below the quotations of the A. S. & R. Co., namely, at 5.75c. New York. In the past few days there have been extremely large deliveries against the heavy purchasing in the excitement of a few weeks ago. At this writing the market is very dull, and is lower. The New York quotation July 15 was down to 5.60c. It is pointed out that a sudden change may be expected, inasmuch as the relation between supply and demand is closer than usual. Foreign buying has been lighter, as might be expected when London is below New York parity. The exports, to July 17, amounted to 1144 tons. Italian interests have made inquiry recently and their failure to culminate in orders leads to the belief that the demand was satisfied with Spanish lead. The unwillingness of England to permit the exportation from her shores of any of the metals is favorably regarded, as it may force other European nations to replenish their stocks direct from the United States.

ZINC

The demand has been irregular, and while prices were about to touch 23c., July 8, they soon weakened under a lessening demand and freer offerings. By July 14 prompt deliveries were quoted at 22c., and even this figure might have been shaded. London continued steady at £100 per ton for some days, but on July 15 dropped to £96. August spelter is stronger, relatively, than July, for the reason that most consumers are supplied for the first month and not for the latter. There were export inquiries and buying about a week ago, when quotations ranged from 22.50 to 23c. for prompt, 22c. for August, and 20c. for the last quarter of the year. On July 16, the quotation for prompt was down to 21.25c. Sales of prime western have been made in the past few days for delivery into next May. Brass-mill grades continue to command fancy prices, and for Bertha and Horsehead, made by the New Jersey Zinc Co., 40c. has been offered. The miners' strike in the Joplin district, which, strangely enough, seemed to have but little effect on the situation, was ended early this week. It is understood that no immediate concessions were granted by the employers. The exports, July 1 to 17, totaled 2073 tons.

TIN

For several days the market has been dull and uninteresting. The situation is due to consumers being well covered, the liberal supply and prospective arrivals, while speculation is at low ebb. The arrivals up to July 17 totaled 2639 tons and there was afloat on that day 5710 tons. Quotations have declined, until 38.90c. was reached July 9. That of July 12 was 38.62½c., that of July 13, 38.12½c. and of July 14, 37.75c. According to Metal Exchange figures the stock of unsold Banca tin stored in Holland, June 30 was 1146 tons, against 2861 tons, January 31.

ANTIMONY

Recent arrivals of Chinese and Japanese antimony and subsequent freer offerings have given an easier tone to the market, and 36c. has been shaded, although the general range of quotations is unchanged at 36 to 37c., New York. The market has been quiet.

ALUMINUM

Small lots of aluminum continue to command 31 to 33c. Sheets are quoted at 34 to 36c. per pound.

Oil production of the United States in 1914 totaled 290,312,535 bbl., a large increase. The average price was 80.6c. per barrel. California produced 99,775,327 bbl., at 46.7c. per barrel.

MINING DECISIONS

OIL AND GAS LEASE—ASSIGNMENT—WARRANTY

An oil and gas lease is a chattel real. But in case of an assignment by the lessee of all his "right, title and interest" therein, where the assignee has knowledge of a prior existing lease, the general rule applicable to sales of personalty that the act of selling is in itself an affirmation by the vendor that he is the owner, out of which arises an implied warranty of title, does not obtain.

Tupeker *v.* Deaner (Oklahoma), 148 Pacific, 853. May 11, 1915.

SUBSIDENCE OF SURFACE—MEASURE OF DAMAGES

Where, by reason of coal mining beneath certain land, the surface was caused to subside for lack of sufficient props to support the roof of the mine, the lessee who was operating the mine and not the mine owner was responsible to the owner of the surface for damages caused by the subsidence. The measure of these damages was the difference in value of the land before and after the subsidence.

Jackson Hill Coal & Coke Co. *v.* Bales (Indiana), 108 Northeastern, 962. May 28, 1915.

MINING PARTNERSHIP—DISTINGUISHED

Where a party is employed by another to look after certain mining claims and sell the same when opportunity afforded, his compensation to be one-half of the net proceeds after deducting expenses of sale and reimbursing himself for any personal advances theretofore made, his relationship is purely one of trust and he is not in any sense a 'mining partner' nor can he be sued for wages alleged to be due a watchman employed by his principals.

Peterson *v.* Beggs (California), 148 Pacific, 541. March 15, 1915.

EXTRALATERAL RIGHTS—INTERSECTION OF VEINS

In a suit brought for injunction to restrain trespass and damages for taking of ore at the intersection of two veins on their dip, the trial court found that the owner of the senior claim was within his extralateral rights on a vein apexing within his own claim. It follows, as a well established rule of law that he was entitled, by reason of his senior location, to the ore lying within the intersection of the two veins. Injunction denied the junior claimant.

Esselstyn *v.* U. S. Gold Corporation (Colorado), 149 Pacific, 93. June 7, 1915.

DAMAGES FOR TRESPASS—EVIDENCE

A judgment for the plaintiff in an action to recover the value of ore alleged to have been taken by defendant from two veins apexing in plaintiff's mining claim, but extending on their dip beyond its vertical side-lines beneath the surface of defendant's adjoining claim, rendered under a stipulation that only the issue of title and right to possession of the veins and ores in controversy should be tried, leaving the question of damages to be later disposed of, was construed to relate only to the title and right to possession of the ore in the two veins which were in issue in the first case. The defendant was entitled, on the subsequent trial of the issue of damages, to show that a portion of the ore taken from its claim within such claims was from other veins than those involved in the first suit. Hence the evidence offered by defendant to prove this point was material in that it might lessen the damages plaintiff was entitled to recover and should be submitted to the jury.

Work Mining & Milling Co. *v.* Doctor-Jack Pot Mining Co., (Colorado), 222 Federal, 216. February 17, 1915

RECENT PUBLICATIONS

CALIFORNIA'S MAGAZINE. Vol. 1, No. 1. Cornerstone Number. Edited by E. J. Wickson. P. 672. Illustrated. California Publishers Co-operative Association, San Francisco, July 1915. All phases of Californian activities are discussed and illustrated in this interesting work.

University of California, Berkeley, 1915:

OCCURRENCE OF OLIGOCENE IN THE CONTRA COSTA HILLS OF MIDDLE CALIFORNIA. By Bruce L. Clark. P. 22.

NEW SPECIES OF THE HIPPARION GROUP FROM THE PACIFIC COAST AND GREAT BASIN PROVINCES OF NORTH AMERICA. By John C. Merriam. P. 9. Illustrated.

COKE-OVEN ACCIDENTS IN THE UNITED STATES, 1913-1914. Compiled by Albert H. Fay. Technical Paper 118. P. 16. U. S. Bureau of Mines, Washington, D. C., 1915. There were 46 killed and 2514 injured in 1913, and 45 and 2189 in 1914, 24,345 and 22,313 men being employed in these years. In the former year there was 46,299,530 tons of coke made from 69,239,190 tons of coal, in 102,650 ovens.

Topographic and Geologic Survey of Pennsylvania publications, Harrisburg, 1914. Richard H. Hise, state geologist:

MINERAL PRODUCTION OF PENNSYLVANIA IN 1911. Quarry Products. Report No. 8-E. P. 84.

ENGINEERING DATA. Report No. 7. P. 450. Maps.

GEOLOGIC MAP OF SOUTHWESTERN PENNSYLVANIA. Report No. 2.

COAL AND COKE. Report No. 8A. P. 139.

CLAY AND CLAY PRODUCTS. Report No. 8C. P. 51.

U. S. Geological Survey, Washington, D. C., 1915:

PRODUCTION OF PHOSPHATE ROCK IN 1914. By W. C. Phalen. P. 16.

FUEL BRIQUETTING IN 1914. By Edward W. Parker. P. 4.

FAUNA OF THE WEWOKA FORMATION OF OKLAHOMA. By George H. Girty. Bulletin 544. P. 353. 35 plates, index.

RESULTS OF SPIRIT LEVELING IN UTAH, 1897 TO 1914. Bulletin 566. P. 77. Ill., index.

CONTRIBUTIONS TO ECONOMIC GEOLOGY. Short papers and preliminary reports, 1913. Part II.—Mineral Fuels. Bulletin 58. P. 187. Ill., maps, charts, index. Authors are as follows: E. G. Woodruff, D. T. Day, C. T. Lupton, V. H. Barnett, R. W. Pack, W. A. English, and C. H. Wegemann.

Water-supply papers of the Survey:

PACIFIC COAST BASINS IN CALIFORNIA. Compiled by B. D. Wood. No. 340-K. P. 50.

YUKON-TANANA REGION, ALASKA. By C. E. Ellsworth and R. W. Davenport. No. 342. P. 343. Ill., maps, charts, index.

LOWER MISSISSIPPI RIVER BASIN. No. 357. Prepared in co-operation with the state of New Mexico. P. 86. Ill., index.

WATER RESOURCES OF THE RIO GRANDE BASIN, 1888-1913. By Robert Follansbee and H. J. Dean. Also Part VIII, Western Gulf of Mexico Basins. By Robert Follansbee, W. W. Follett, and Glenn A. Gray. P. 725. Ill., map, index.

GEOLOGY AND ORE DEPOSITS OF COPPER MOUNTAIN AND KASAAN PENINSULA, ALASKA. By Charles Will Wright. Professional Paper 87. P. 110. Ill., 22 plates, maps, index.

EOCENE GLACIAL DEPOSITS IN SOUTHWESTERN COLORADO. By Wallace W. Atwood. Professional Paper 95-B. P. 26. Ill., map.

THE PLEISTOCENE OF INDIANA AND MICHIGAN, AND THE HISTORY OF THE GREAT LAKES. By Frank Leverett and Frank B. Taylor. Monograph. Vol. LIII. P. 529. Ill., charts, maps, index.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Cleaning Hollow Drill-Steel

With the advent of the Jackhamer and similar machines using hollow drill-steel, a new trouble developed which has been the cause of considerable annoyance and added expense. The hole in the hollow steel often becomes plugged with particles of cuttings and dirt. As soon as a 'steel' is clogged in this way it is useless until cleaned out, as the function of the hole in the steel is to permit passage of air to keep the bottom of the drill-hole clear; in water-drills, like the Leyner, to allow a thin stream of water to pass through by air pressure and wash out the cuttings. At times, however, as experience shows, the dirt will get into the steel and plug up.

PNEUMATIC DRILL FOR CLEANING HOLLOW DRILL-STEEL.

Perhaps the most frequent method heretofore employed, particularly when only a few drills are used, has been to heat the steel, after which it is an easy enough matter to remove the obstruction with a long thin wire, or by air pressure through a nozzle. As can readily be seen this method takes some time and labor. Also care must be taken when heating so as not to destroy the temper of the steel.

Another method of abstracting the dirt, which is far more economical and rapid, is to use a light pneumatic drill. The plugged steel is first laid out before re-sharpening the bits, and a jet of air is applied through a nozzle. In many cases this air pressure is sufficient to clean the steel, but if the obstruction cannot be removed with the air-jet, the pneumatic drill is employed. With the $\frac{7}{8}$-in. hexagon hollow Jackhamer steel, $\frac{1}{4}$-in. wire is used; with steel having a larger diameter hole, such as the $1\frac{1}{4}$-in. or $1\frac{1}{4}$-in. steel used with the No. 18 Leyner-Ingersoll machines, a correspondingly heavier wire can be applied. If the drill-steel is plugged about three feet from the shank end, a $3\frac{1}{2}$-ft. wire is long enough. If, however, the obstruction is, say, about 3 or 4 in. in from the shank end, a wire from 6 to 8 ft. long is required, working from the bit end of the steel. Of course the time required to remove the dirt depends on its depth and hardness. It usually takes from one to five minutes. Compared with the method described above, this represents a large saving in time, according to Coly M. Olson.

The pneumatic drill employed for this service is manufactured by the Ingersoll-Rand Co. and is known as the No. 44 Little David non-reversible drill. It weighs only 10 lb. It has a pistol-grip handle, is $15\frac{1}{2}$ in. overall, with a cylinder bore of $1\frac{1}{4}$ in. and a $\frac{3}{4}$ in. stroke. Air consumption is about 17 cu. ft. of free air per minute, at 90 lb. pressure. It is also equipped with a speed regulator by means of which any speed from 1500 to 3000 r.p.m. may be obtained. This drill can also be used for drilling up to $\frac{3}{8}$ in. diameter holes in metal. It has a simple revolving motor, is well-balanced and entirely free from vibration, so the operator has no trouble in handling it. It is admirably suited for the purpose above mentioned.

Electric Incline Railway

An incline railway, which might suit some mining companies, has recently been installed at Hamilton, Ontario, by the Hamilton Mountain Park Co., Ltd. It is used for transporting passengers, freight, automobiles, trolley-cars, teams, etc., up the mountain, the difference in elevation being 325 ft. The machinery was formerly steam driven. The electric hoist equipment, containing many novel features and automatic safety-devices, was supplied by the Canadian General Electric Co., Ltd., a connection of the General Electric Co. of Schnectady, New York. A double fixed-drum, double-geared electric incline hoist, built by the Lidgerwood Mfg. Co., New Lork, operates two 15-ton platform cars in balance, on an incline 800 ft. long, with a grade of 40.27%. The average load is 10 tons. Each trip takes 1.5 minutes. Attached to each car are

HAMILTON MOUNTAIN PARK ELECTRIC HOIST, SHOWING BOTH MOTORS AND GEARED CONNECTORS TO DRUMS, ALSO SOLENOID-BRAKES, CLUTCH, AND FLYBALL SPEED LIMITING DEVICE.

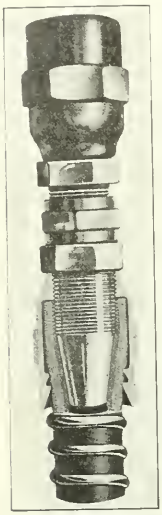
two $1\frac{5}{8}$-in. diameter ropes, one for hauling, the other for safety. The average rope-speed is 585 ft. per minute. Sheave arrangement, operation of hoist and safety ropes, safety appliances, automatic overwinding mechanism, overspeeding device, shaft, drums, gears, electric equipment, including the Electric Storage Battery Co.'s of Philadelphia battery, load-demand, etc., are all described in the paper sent us by the General Electric Company.

Motors for Flotation Agitation

Power consumption is an important item in flotation processes in which mechanical agitation is used to produce the froth. A direct-connected agitator has been devised by the engineers of the Westinghouse Electric & Manufacturing and the Utah Copper companies. The machine has given such good service that over 500 are now in use. The design has since been followed by other manufacturers. The agitator paddles are mounted on a short section of shaft fitted with a cup-shaped bushing, threaded on the inside. The shaft of the vertical-suspended motor is virtually a continuation of the agitator-shaft, and is threaded on the outside, the two being screwed together. The motor is 10-hp., 440-volt, 3-phase, 60-cycle, 12-pole running at 575 r.p.m. full-load speed. The special features of this motor are the heavy thrust-bearing at the top, and the heavy guide-bearing at the bottom. There is no step-bearing in the agitator cell, and the entire weight of the revolving part of the motor, the motor-shaft, the flange-coupling, the paddles, and the paddle-shafts, is suspended from the thrust-bearing in the top of the motor. The heavy guide-

bearing at the bottom of the motor-housing is made with large bearing-surfaces and heavy webs holding it to the bearing-bracket, so that it will absorb any lateral thrusts which might develop, due to a slightly unbalanced paddle revolving at such a high speed.

New Hose Coupling

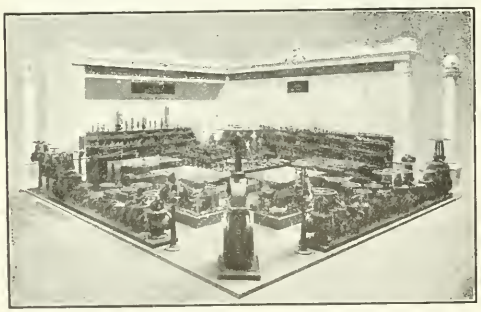


NEW HOSE COUPLING.

In its 'National' hose coupling the NATIONAL HOSE COUPLING Co., Peoples Gas building, Chicago, claims that for railway, shop, shop air-tool use, foundries, rock-drills in mines and quarries, hose connection to water-pipes, packing house steam hose connections, and everywhere that hose meets hard service nothing is superior to its hose coupling, as illustrated. No special tools are required for its use. The malleable iron hose socket is sufficiently corrugated on the inside to provide a positive grip when the hose is expanded, and simply screwing the steel taper expander into the socket forces the hose outward and into position. The hose readily enters the socket and may be cut and re-coupled as often as required in the same way. The edge of the socket and end of expander are smoothly rounded to prevent injury to the hose. The only pressure on the hose is from the inside. A price-list is given.

Valves, Lubricators, and Fittings at the Exposition

In the Palace of Machinery at the Exposition at San Francisco, the Lunkenheimer Co. of Cincinnati, Ohio, has an artistic display of its engineering appliances. In great variety are displayed bronze, iron, puddled semi-steel and cast-steel globe, angle, cross, check, gate, balanced-throttle, and non-



PIPE-FITTINGS AT THE EXPOSITION.

return safety boiler stop-valves; also bronze and iron pop safety, relief, and blow-off valves; water-columns and gauges; whistles, ground key-work, injectors and ejectors; bronze fittings and unions; cylinder lubricators, oiling devices, oil and grease-cups; automobile and motor-boat specialties, and many other fittings of high-grade quality.

In *Graphite* for July, the Joseph Dixon Crucible Co., New Jersey, describes a deep well pump at Bowie, Texas. The delivery from 500 ft. is 160 gal. per min. Main bearings have a pressure of 25,000 lb. Cylinder oil and flake graphite are used on bearings and gear.

Commercial Paragraphs

In seccion U-cuarta edicion, CHALMERS & WILLIAMS of Chicago Heights have described the Symons-disc-crusher in Spanish.

The DU PONT NITRATE Co., Wilmington, Delaware, is installing a Chalmers & Williams, Chicago, 24-in. and a 48-in. Symons disc-crusher at the nitrate works in Chile.

Truck catalogue F-3e of the THOMAS B. JEFFREY Co., Kenosha, Wisconsin, describes the "truck that solves all the problems in road transportation," the 'Jeffrey Quad.'

Ball-tread tractors made by the YUBA CONSTRUCTION Co., Marysville, California, are exhibited in the Palace of Agriculture at the Exposition. Those shown are No. 12 and 18 sizes. The gear is shown in a separate exhibit.

At a meeting of the directors of the AMERICAN LOCOMOTIVE Co., New York, held on July 14, W. Spencer Robertson was appointed secretary of the company to fill the vacancy caused by the resignation of C. B. Denny, effective this date.

The BURD HIGH COMPRESSION RING Co., Rockford, Illinois, reports that it is beginning the installation of machinery in an additional new factory building, containing 30,000 sq. ft. of floor-space. Waiting and new contracts have rendered necessary this increase in plant.

The VULCAN ENGINEERING SALES Co., Chicago, general agent for the Hanna Engineering Works, Mumford Molding Machine Co., and the Q. M. S. Co., sends us a short description and picture of the Hanna vertical suction-oiler. It is automatic in action, and gives the correct quantity of lubricant at the right time.

Bulletin 11D of the NATIONAL TUBE Co., Pittsburg, in 48 pages discusses the history, characteristics, and advantages of 'National' pipe. Bulletin 24 covers the rise in steel pipe. In 1905 wrought-iron pipe made was 452,797 tons, and steel, 983,-198 tons; in 1913, the respective figures were 312,746 and 2,-189,218 tons.

In a 42-page catalogue the LOCOMOBILE Co of America, at Bridgeport, Connecticut, illustrates and describes its 3 and 4-ton worm-drive trucks. These are lighter, more mobile, and more economical than the 5 and 6-tonners. The overhead type or straight worm drive is used. The worm is of nickel-steel, hardened, and the teeth ground after hardening. These trucks are suitable for all kinds of work, including carrying coal, water, oil, pipes, ore, and concrete materials.

The frontispiece of a 30-page booklet of the MINE & SMELTER SUPPLY Co., Salt Lake City, Denver, El Paso, and New York, shows No. 86 in the erecting-shop, one of twenty Marcy ball-mills for the Inspiration copper mill, Arizona. This machine is gaining favor in many centres. It is designed and built to sucessfully take the discharge of jaw and gyratory-chusher, 2 or 4 in., and with 'One Easy Step' produce a non-selective product of 10, 20, 40, or 80-mesh, all passing the meshes given. An article on the practice and design of wet-crushing ball-mills is giveu by F. E. Marcy. Both plain and herring-bone gear is made for these machines.

The MORSE BROS. MACHINERY & SUPPLY COMPANY, of Denver, Colorado, has purchased the entire power plant recently erected at Wilkenburg, Arizona. This plant was built to furnish power for the Octave Mining Company, 14 miles distant. The power being generated at the railroad and transmitted to the mine. The plant consisted of 200 and 550 kw. Westinghouse generators driven by Corliss engines. The steam plant consists of B. & W. boilers, fired with oil. The transmission line was operated at 22,000 volts, and is fourteen miles long. All of this material will be dismantled and sold, or removed to their Denver house. The smaller unit was in use three weeks, and the larger one was never used.

EDITORIAL

T. A. RICKARD - - - - Editor THOMAS T. READ - Associate Editor

JAPANESE copper is arriving in London. Japan produces about 75,000 tons of the metal per annum.

THE index to volume 110 of this journal has been prepared and will be sent to any of our subscribers, on request.

STEEL is the barometer of industry. Conditions in the steel industry are reflected in the quotations for United States Steel Corporation shares. The rise is significant.

EXPORTS of zinc from Australia to the United States have been sanctioned by the British government to the extent of 50,000 tons of concentrate, averaging about 47%. It remains to be seen whether that amount can be marketed here.

DECLARATION of war by the United States would be followed by the intensified manufacture of munitions and an insistent demand for copper, lead, zinc, and antimony. Yet we hope that no such declaration may prove necessary.

NOTHING has come of the investigation into the alleged spelter trust. Officials in Missouri have been able to find no evidence to justify the allegation that the price of ore was fixed by the buyers at Joplin. We considered it a mare's nest from the start, although always wishing well to the producers of ore in Missouri, and elsewhere.

CONDITIONS in Mexico are discussed in special correspondence from Mazatlan and London. We also give some notes on the currency problem in Sonora. The National City Bank of New York estimates that paper money to the nominal value of 1,000,000,000 pesos has been forced upon the population of Mexico during the last 18 months.

GAMBLING in war stocks has been the chief characteristic of Wall Street dealings for several months. It is exciting, and fully as dangerous as dancing on the edge of a volcano. Eventually there will be a lurid day of reckoning. Meanwhile it makes the market highly professional, for the public is, we are glad to think, abstaining from the orgy.

IMPORT of a single shipment of 300 flasks of quicksilver from Italy into New York two weeks ago is accompanied by the explanation that the embargo on exports of quicksilver from that country has not been relaxed, but the single shipment was allowed to proceed, as it had been contracted and paid for before the embargo was declared. No further shipments will be permitted.

HAVING been through the ordeal of fire ourselves, we sympathize with our vigorous contemporary the *Valdez Daily Prospector,* which was burned out of house and home on July 15. However, on the same day a single printed sheet was issued just to show that it is not paper and machinery that make a newspaper, but the spirit that gives life to the printed word. We congratulate our friend in the North.

ACCORDING to current statements the loans issued by the belligerents in Europe make a total of $16,000,000,000; it is estimated that the casualties to date in the War (that is, dead, wounded, and prisoners) amount to 10,000,000 men; we estimate the horror and suffering caused by the War at $1,000,000,000

ton. An operating cost of 64 cents per ton is reported, as against the estimate of 75 cents. Even allowing for a small addition to cover depreciation and overhead charges, this is a notable achievement.

PROSPERITY is warming the hillsides and canyons of the mining districts tributary to Salt Lake. On the first day of August the increase in wages granted voluntarily by the mine operators goes into effect. From 15 to 25 cents more per working shift is to be paid; this means that $750,000 more per annum is to be distributed in the region as a whole. The new wage-scale affects 7000 men.

LITIGATION is much in the air. While the Emma Copper company, in the Little Cottonwood district, Utah, may escape an apex-suit, said to be threatened by the owners of the Cabin claim, it is a fact that two suits have been started by the North Star Mines Company against the Empire Mines & Investment Company at Grass Valley, California. This promises to be a complicated case, involving geological and legal evidence of a most interesting character. However, it relates to the ownership of a magnificent orebody, of which the larger portion remains yet to be extracted.

ON another page we publish a copy of the contract under which Bolivian tin concentrate is sold to European smelters. We are indebted for this to Mr. Luis Abelli, commissioner for Bolivia to the Panama-Pacific International Exposition. Much attention has been given during the past year to the possibility of smelting Bolivian tin concentrate in this country, and, in thus making public the terms under which the business is usually negotiated, Mr. Abelli renders timely assistance to the firms that are considering a venture in the smelting of South American tin ores.

IN Mr. T. J. Hoover's book—the only book—on 'Concentrating Ores by Flotation,' he gives the average royalty levied by the process-owners as 25 cents per ton. The combined capital of all the companies exploiting the flotation patents is about $5,000,000. Therefore royalty at 25 cents per ton must be paid on 20,000,000 tons of ore before the capital is returned. These companies have been in existence for over 10 years, so that if they return 10% per annum, as they should, they must treat 20,000,000 tons more. As yet they have done about half of this total requirement of 40,000,000 tons. As Mr. Hoover suggests, this simply indicates that they have been overcapitalized and burdened with the cost of litigation.

The Mexican Impasse

Mr. Roosevelt, in his speech at the Exposition, referred to Mexico and said: "Conditions in Mexico are such that, unless the Mexicans themselves come to their senses and unless we are content to see foreign powers undertake the regulation of Mexico, we may ultimately have to intervene. Such intervention would not represent real war, but a work of pacification and police." From Washington it is reported that "a definite step toward settling the Mexican problem will be taken by the United States government in the near future." It sounds familiar, but we believe it to be true. Indeed the Mexican habit of mañana characterizes all things Mexican, even the vital problem of restoring law and order. It is said the graver responsibilities of the President in regard to the European position prevent him from proceeding with his efforts to help the Mexicans in obtaining some sort of government. On the contrary, we venture to surmise that the Mexican trouble may prove a timely safety-valve for the belligerent spirits in this country. If some expression of activity is required it would be well to direct it across the Rio Grande rather than over the Atlantic. Events continue to have what seems to us a favorable trend. Zapata and Villa are in a weak military position and show a willingness to co-operate with the peace-makers. Carranza talked big for a time, but his affairs also look none too promising. Important defections from both sides are reported and several leading men not too closely aligned with the existing factions are making a move looking toward some form of co-operation. Felipe Angeles, Eduardo Iturbide, and Eulalio Gutierrez are mentioned, besides Maytorena and some of the Madero family. This looks promising. Meanwhile both the Mexican people and the South American governments are becoming reconciled to the idea of American assistance in restoring a national government in Mexico, for it has been shown beyond a doubt that the United States has no sinister designs on its neighbor's property.

The Amateur Miner

A few days ago we received a visit from a gentleman who came to ask our advice in regard to the best way of taking an active share in the business of mining. That probably was not the way he would have phrased it when he handed his card in the outer office, but that assuredly was the idea at the back of his head. He was the type of quiet-mannered and well-educated New Yorker, with plenty of money and time on his hands, prompting him to a financial adventure on the romantic frontier of mining. He said that in New York he had met a man named Blank, who was an experienced miner and was willing to set out in search of a mine, if provided with $125 per month and allowed a half-interest. The New Yorker—let us call him Mr. Gray, for that was the color of his habiliments—asked us if we knew anything about Blank; to which we replied in the negative. We advised him that the proposal was an ordinary 'grub-stake,' which was excellent when the contracting parties knew each other, but inadvisable when one of them had all the money and the other all the experience. Thereupon he asked us what we considered the best way of participating in mining. That was a large question. We asked him several in exchange and ascertained that Mr. Gray did not care to buy shares; he thought it foolish and highly uninteresting to become a minority shareholder, for he wanted to take part in the actual organizing and

operation of a mine. Thereupon we suggested that before he committed himself financially to any scheme, he should visit a number of mining districts. If he cared to ride, he might take a horse and go from Mariposa to Plumas county, the whole length of the Mother Lode, stopping at the various mines on the way, so as to obtain information, not only at the mines, but by conversation with the people he would meet in the course of his pilgrimage. However, it appeared that he was more of a yachtsman than a horseman, so that idea did not bite. Then we suggested a motor-car and a tour through Amador, Grass Valley, Reno, Tonopah, Goldfield, and Ely, assuring him that three months of intelligent observation would open his eyes so that he could proceed with more safety on his proposed mining venture. After such a preliminary canter, we thought he should return to New York and discuss the matter with one or two mining engineers of his own social stratum, members possibly of his club, the name of which he divulged. We mentioned two engineers who themselves were looking for possible mines, men of experience and technical training, as well as of capital, who might be willing to admit him to a participation in a venture with a risk much less than that to be incurred by him if he played a lone hand. He rather liked that suggestion, and politely accepted one or two names and addresses. If he had the necessary capital and was seriously bent on sane speculation in mining, he would, we felt sure, obtain a run for his money under the guidance of the men mentioned. Having obtained preliminary experience in their company, he would acquire a first-hand knowledge of the mining business, sufficient to warrant him in proceeding on his own initiative, provided always that he took, and paid for, the advice of an experienced mining engineer before committing himself heavily.

That, frankly, was our advice. Perhaps some of our readers can suggest a better method of starting an inexperienced man on the difficult road of an intricate business. We shall be glad to publish their views.

About Flotation

In this issue we publish a few interesting details concerning the application of the flotation process to copper ore at Engels, in California. Mr. T. T. Read describes how an ore not amenable to ordinary wet concentration is being treated by flotation, yielding a concentrate rich enough to warrant shipment to the Garfield smelter, in Utah. This is not the only flotation mill in California, for the Mountain Copper Company is operating a Minerals Separation flotation plant having a capacity of 250 tons of ore per day, using an acid solution. The little mill at Engels, however, is notable because it represents a single treatment, not a mere supplement to older methods. At Miami, for instance, 40% of the ore is submitted to wet concentration only and is never touched by froth, while 30% is treated by flotation only, leaving another 30% that undergoes successive treatment, first by water and then by oily froth. At the Butte & Superior, on the other hand, while 40 to 50% of the concentrate made in the mill is the result of tabling and jigging, there is no discard except from the flotation department.

In all of these cases the metallurgical treatment is not completed; it stops at the stage of producing a concentrate, without attempting to extract the metal itself. This will suffice for copper ores, particularly in districts tributary to established smelters, but the concentrate from a gold and silver ore will invite further reduction on the spot, to the point of an extraction expressed in terms of bullion.

Our own information leads us to conclude that trials are being made with the new process—'new' in its latest phase—in localities all over the country. The intelligent curiosity of the mining public has been aroused to the importance of this method of concentration and every wide-awake millman or metallurgist is applying it tentatively to his own ore. Tests can be made easily because the process requires no elaborate apparatus. For instance, in the case of many ores mere shaking of pulp with a little oil in a bottle will suffice to make a separation, as is indicated by the simple tests made by the California University students, whose amateur but intelligent research is recorded on another page of this issue. Again, an ordinary soda-water siphon can be used, if only the cap of the bottle is strengthened so as to permit of the pressure within the bottle being raised by a bicycle-pump to, say, 30 pounds per square inch. A charge of 4 ounces of powdered ore, 12 ounces of water, and a few drops of oil (say, in the proportion of half a pound of oil per ton of ore) is introduced into the bottle, which is then shaken vigorously so that the air will dissolve in the mixture. Then the lever is depressed and the foaming contents discharged into a beaker, where separation ensues, the froth remaining on top, with its burden of mineral, while the particles of gangue sink to the bottom. The operation is essentially one of separating valuable mineral from valueless gangue by means of the selective action of the froth on the particles of the former. Another simple type of apparatus for a small test is the separatory funnel used in ordinary analytical work. As for oil, the coal-tars, creosotes, and pine-oils can be used, the thicker tars being thinned by the addition of a little turpentine. In some parts of the world, eucalyptus oil will be easiest available. The siphon method and other simple devices for making tests are described in Mr. T. J. Hoover's book on 'Concentrating Ores by Flotation.' This is the only book on the subject and has a timely value it would be difficult to exaggerate, for the information available on the process is singularly small. In various technical publications the student will find references to the various patents and to the litigation incidental thereto, but to the average man most of this information is vitiated by prejudice, and therefore confusing. The tax on knowledge imposed by patent litigation has never been more unpleasantly manifest than in this department of metallurgical work.

The making of tests, of course, does not involve the payment of royalty to anybody, but with the first at-

tempt to operate the process on a commercial scale there rises the bogey of the patent-owner. Just now the principal patent is the subject of litigation, so that it is not known who, if anybody, has the right to collect a royalty, but the uncertainty may be cleared, in some degree, at an early date, by a decision in the cases now pending. That of Minerals Separation *v.* Hyde was won by defendant on appeal and then by writ of *a certiorari* it was brought before the Supreme Court, where it now rests. Meanwhile the more recent suit of Minerals Separation *v.* Miami, supported by several other important copper companies, will be adjudicated by the District Court at Wilmington in October and will then go to appeal, of course. The decision in the one case may affect the other, but the present litigation will not be settled until the court of last resort has given its opinion. Indeed, the real scope of a patent is not defined until it has passed through the ordeal of successive lawsuits. Then it emerges in the form of a chastened statement sufficiently definitive to warn infringers of their legal limitations. It is a pity that the legal machinery should be so cumbersome as to necessitate years of expensive litigation in order to determine the relative rights of the inventor and the public. These rights could be adjudicated in a single hearing if brought before a court constituted to try such issues only. It is regrettable that the owners and the users of metallurgical ideas or devices should have to descend into the dusty arena of the law-courts. The performance is always expensive and usually unsatisfactory. Before the critical case between Minerals Separation and the Miami company went to trial, several sincere efforts were made to compromise the difference. These efforts failed, as similar previous efforts in London had failed likewise to find an adjustment of conflicting claims. Oil, it is said, stills the troubled waters; but it has a curiously belligerent, if not vindictive, effect upon inventive metallurgists and their patrons. Perhaps it is the acid that causes the acerbity; then we may hope for gentler feelings when the alkaline treatment is generally adopted. In truth, much of the trouble is due to ignorance of human nature; or the ignoring of it, shall we say? For instance, we ask a metallurgist what royalty he would demand if a device of his enabled a mine to save an additional 40 cents per ton; he replies, 5 cents. That is an eighth. When we inquire what royalty the Miami is expected to pay Minerals Separation, we are informed that it is at the rate of $\frac{3}{8}$ cent per pound of copper, but never less than 12 cents per ton of ore treated by the process. That seems not unreasonable, but on a big tonnage, over many years, it is considered oppressive. An extra saving of 10% on a 2% copper ore, with copper even at 15 cents, represents 60 cents per ton. To pay a fifth of the saving may not appear excessive to the onlooker, but to the payer it looms unpleasantly large. The latter would prefer to pay a lump sum and get rid of the incubus. The restrictions imposed on the licensee are apt to prove irritating and the effort to monopolize knowledge is bound to provoke resentment. As a matter of fact, the money made from metallurgical improvements usually is not derived from royalties so much as from the manufacture of the plant and the engineering services that go with it. If a patentee or a company owning a patent has devised an effective process or a successful machine, it is wise to employ his or its experience in the application of the process or the machine, and, provided the royalty charged is not oppressive, it is advantageous for the operator to go to him or it for engineering services in the erection of a plant of which the process or the machine may form only a part. This is the story of the successful work done by Charles Butters, J. V. N. Dorr, H. W. Hardinge, Alfred James, C. W. Merrill, E. A. C. Smith, and other inventors. The average man has a natural dislike to looking down the barrel of a pistol—even if it is not loaded.

Oil Films on Water

Students of the physics of flotation as applied to ore-dressing will do well to familiarize themselves with the researches of M. Henri Devaux, professor in the University of Bordeaux, who has for the past fifteen years been engaged in investigation of the phenomena exhibited by oil-films on water-surfaces. A résumé of his papers on this subject was published in the Annual Report of the Smithsonian Institution for 1913. Among the most significant discoveries of M. Devaux is that when oil is dropped on the surface of water it spreads out into a film one molecule thick. In carrying out his investigation he used a dilute solution of tri-oleate of glycerine in benzol; when this is dropped upon water it spreads out and the benzol evaporates almost instantly, leaving behind a thin film of oil. Knowing the area covered by the oil and the volume of the oil used, he was able to calculate the thickness of the film, finding it to be one-millionth of a millimetre, or approximately one-twenty-five-millionth of an inch. This corresponds very closely to the known value for the diameter of a molecule of tri-oleate of glycerine. M. Devaux further determined by experiment that if a larger quantity of oil than that required to yield a film of this thickness is used a thicker film is not formed, but the excess of oil gathers together in drops, leaving the film elsewhere at its normal thickness. The data gathered in this and other investigations have been employed by M. Devaux in the study of molecular phenomena, but it serves as a good example of how research of apparently the most academic character may serve to throw light upon industrial processes. If films of oil on water are only the thickness of a molecule, it is no longer puzzling that a small fraction of a pound of oil per ton of ore is so effective in ore-dressing by flotation, nor that the use of larger quantities of oil does not improve the results attained. No doubt many other facts learned by workers in the field of pure science can be applied to elucidate the phenomena of flotation. We recommend investigators in this new branch of metallurgy to familiarize themselves, so far as practicable, with the work of investigators in related fields of research.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more vaulable than casual compliment.

Mining Claims in National Forests

The Editor:

Sir—In the July 10 issue of the PRESS is an article on 'Mining Claims in the National Forests' that on its face is beyond criticism, but, like all such articles, it ignores the principal objection to the administration of the Forest Reserves, namely, that while Congress authorized the establishing of Forest Reserves for a specific purpose, that purpose has been used as a blind under cover of which forest reservations have been established not only in disregard of the purpose of Congress, but in absolute defiance of the express provisions of the statute. One section of the Act of June 4, 1897 is as follows: "No public forest reservation shall be established, except to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States; but it is not the purpose or intent of these provisions, or of the act providing for such reservations to authorize the inclusion therein of lands more valuable for the mineral therein, or for agricultural purposes than for forest purposes." A President of the United States, at the request of the Forester, set aside as Forest Reserve mineral land in Colorado above timber-line, mud-flats in Alaska that are washed by the tide every day, sage-brush deserts in Arizona and New Mexico, and treeless table-lands in Colorado. These reservations were made, not to protect timber and watersheds, as Congress directed, but to control the location of mining claims, to levy a tax on the livestock industry in the case of grazing lands, and in the case of the mud-flats on the border of Controller bay in Alaska probably for the purpose of obtaining revenue by leasing to shipping interests. But whatever their object, these reservations were not only gross usurpation that are not entitled to be treated with respect, but are deliberate violations of the statute. When mining men object to having their mining locations controlled by Forest Reserve officers, it is usually because the forest reservations have not been made in accordance with law, and because the law makes the Secretary of the Interior the person who is to decide whether an applicant is entitled to a patent for his claim and not the Secretary of Agriculture. It is, I think, beyond question that Congress authorized the establishing of forest reserves for the sole purpose of preserving the forests on the watersheds of our streams. It is equally beyond question that the Forest Reserve system has been extended over portions of the public domain, not for the purpose of protecting forests, but as a scheme of commercial landlordism for revenue, for which there is no authorization in the law, and it is this usurpation of authority that causes the clashing with mining interests.

H. W. REED.

Salt Lake City, July 15.

The Editor:

Sir—That Mr. Reed is in error regarding the facts is shown by the very wording of the statute the provisions of which he asserts to have been defied. While the Act of June 4, 1897, as Mr. Reed points out, declares that "it is not the purpose or intent of these provisions, or of the act providing for such reservations, to authorize the inclusion therein of lands more valuable for the mineral therein, or for agricultural purposes, than for forest purposes," the same Act in a later section makes the following provision:

"Upon the recommendation of the Secretary of the Interior, with the approval of the President, after sixty days' notice thereof, published in two papers of general circulation in the State or Territory wherein any forest reservation is situated, and near the said reservation, any public lands embraced within the limits of any forest reservation which, after due examination by personal inspection of a competent person appointed for that purpose by the Secretary of the Interior shall be found better adapted for mining or for agricultural purposes than for forest usage, may be restored to the public domain. And any mineral lands in any forest reservation which have been or which may be shown to be such, and subject to entry under the existing mining laws of the United States and the rules and regulations applying thereto, shall continue to be subject to such location and entry, notwithstanding any provisions herein contained."

In other words, Congress recognized that in establishing National Forests covering the main mountain ranges of the West for the purpose of conserving water and growing timber, mineral lands would of necessity be included, and therefore the law made definite provision for such cases. This provision was of two kinds. The law provided that the existing mining laws of the United States should apply in National Forests to any mineral lands "which have been or which may be *shown to be such.*" It also authorized (but did not command) the Secretary of the Interior to restore to the public domain any lands which might be found better adapted for mining or for agricultural purposes than for forest

usage. It is to be noted, however, that in authorizing this action Congress was careful to stipulate a procedure providing many safeguards against ill-advised action or insufficient information, the result of which might be to defeat the purposes contemplated in the creation of National Forests. How, then, can Mr. Reed hold that the reserves were made in violation of the law?

It is surely unnecessary for me to point out that the assertions in the letter to the effect that great reservations were made, not to protect timber and water-sheds, but to control location of mining claims and for other purposes not authorized by the Act, are entirely baseless. While many persons formerly accepted without question sweeping statements of this kind, increased knowledge of the facts regarding the National Forests and the methods and purposes of their administration makes discussion of such appeals to public credulity superfluous. The mere lapse of years since such charges began to be circulated, without effect, in the form of legislation to remedy the alleged wrongs done, should suffice to show that these wrongs are non-existent. Otherwise action would have been taken long ago.

L. A. Barrett,
Acting District Forester.

San Francisco, July 23.

Timber on Mining Claims

The Editor:

Sir—I note in your issue of July 10, 1915, under the title 'Concentrates,' the following paragraph:

"Where two contiguous claims, one having timber on it and the other none, are held by one owner he may take the timber from one claim and use it for development work on the other."

It is believed that this statement does not go far enough in indicating the right of a miner to take timber to support his improvements on a group of claims. This right to take timber is governed by Section 49 of the Penal Code, Act of March 4, 1909 (35 Stats. 1098), prohibiting the cutting of timber on public lands of the United States. This section also provides:

"Nothing in this section shall prevent any miner or agriculturist from clearing his land in the ordinary working of his mining claim, or in the preparation of his farm for tillage, or from taking the timber necessary to support his improvements, or the taking of timber for the use of the United States."

It has been established from the wording of this section and by decisions under it, that if timber is cut from one claim of a group and used upon another, the taking of the timber must tend to develop the claim from which the timber is cut as well as the claim on which it is used. In other words, claims cannot under the law be located merely for the purpose of securing the timber upon them. The intent of the law was to secure to the miner the right to use the timber upon a claim for its development. If a timbered claim is located but no development of it is contemplated or attempted and the timber on it is used on other claims in the vicinity, such use would not be authorized.

L. A. Barrett,
Acting District Forester.

San Francisco, July 21.

Mining Machinery Buyers

The Editor:

Sir—I have read Mr. McDonald's article on 'Mining Machinery Salesmen' with keen appreciation. The selling of mining machinery is more than a mere occupation, it is an art, and therefore allowance must be made for the display of temperament on the part of its many exponents.

Responsibility for such display of temperament must in part, at least, be borne by the buyer, who is often "coy, uncertain, and hard to please." Many learned books have been written with the avowed aim of enabling the reader to arrive at a rational understanding of the psychology of sales. Nevertheless, they have failed to reduce the business to a formula.

Many buyers of machinery regard the salesman and his employers as legitimate game for which there is no close season. Here is a case in point: Some years ago, a well known mining company purchased a large hoisting-engine. Shortly after its arrival on the ground, a claim was made by the mining company for the replacement of the drum, on the ground that the casting was defective. The company was a large and important one, and, what is even more to the purpose, an extensive buyer of machinery and supplies. The manufacturer, in consequence, did not question the truth of the claim, and obligingly supplied a new drum at its own expense, the cost amounting to several hundred dollars. At a visit to the property several months after, the writer learned to his disgust that the reason for the breaking of the drum was that by careless handling, it had been dropped over a bank and cracked beyond hope of repair. The mine superintendent had actually boasted of his shrewdness in thus obtaining a new drum without cost to his employers.

When the day of judgment comes, and the just and unjust are duly separated one from the other, I have no doubt that the majority of mining men will be classified with the former. But there are some who will not.

Here is another irritating trick that has been played on the selling fraternity time and time again, and, I suppose, with some modern improvements, is still being worked in one form or another.

One fine morning, an inquiry for a 20-stamp mill came in through the mail from a small Middle-West town. It bore all the earmarks of genuineness; the specifications had been skillfully prepared, and, in short, it appeared to be a prospective sale worthy of attention. In due course, figures were prepared and submitted by mail, and the result awaited with eager expectancy. Several weeks had elapsed when a telegram was received from the prospective buyer reading something like this: "Bids will be opened for stamp-mill on the tenth. We hope

you will arrange to be represented." Joy pervaded the salesman's office. The prices must have been favorable; if not, why the telegram? However, in order to make assurance doubly sure, a reply was telegraphed to the buyer, who then responded: "Your prices among the most favorable received. Look forward to seeing you." Then followed a visit to the cashier, a rush to the train, and a 1500-mile journey across the continent, during which sweet dreams of anticipation were accompanied by the clicking of the wheels as the miles fled past.

Upon arrival at his destination, the salesman, in the dark of the evening, picked his way from the depot to the one hotel, opened the door, took a look within, and then, tableau!

Nothing but machinery salesmen; salesmen, salesmen, everywhere and not one drop to drink. It was a 'dry' town.

Upon comparing notes, and there is a certain community of spirit among salesmen, even with the deadliest of rivals, it soon developed that precisely the same telegrams had been exchanged between the prospective buyer and all of the others present.

The object of such tactics is simple. It is merely to get as many salesmen as possible together on a single quest. Then by pitting one against the other and permitting an unlimited number of revisions of the bids, to say nothing of letting any one know what all the others have bid, the buyer takes advantage of the reluctance of the hunter to going home without any game, and buys what he wants at a figure close to the limit of endurance of the manufacturer.

Eight of the salesmen present withdrew their bid and declined to take part in the auction. Two remained and bid against one another until one reached the low-water level, and left the victor in possession of the field, triumphant, perhaps, but facing a problematic gain in prestige at the cost of a contract taken at a sure loss. The total expense account for those present aggregated about $1500, which had to be charged against the high cost of selling.

The real buyer of mining machinery, especially when taken in his native habitat, is another man altogether. These exceptions, for exceptions they are, are as opposite to him as the two poles. A busy man always, with a weight of responsibility on his shoulders, nevertheless he is ready with a courteous and hospitable greeting to the visiting salesman. He will permit himself to be bored by the loquacious, irritated by the man who knows nothing but 'talking points,' and will suffer in silence from the typical story-teller. Nevertheless when the dinner bell rings, his invitation to "join us" will have lost none of its heartiness thereby. He is receptive to new ideas, but is conservative with the Missouri tendency that asks to be 'shown.' I count among the pleasantest experiences of my life the men I have met in this way and have since learned to call 'friend.'

Here's to the machinery-buyer, God bless him. I wish there were more of them.

C. T. Hutchinson.

San Francisco, July 15.

Rare Chances

The Editor:

Sir—Apropos of the story of the Columbia student in the editorial 'A Rare Chance,' in the Mining and Scientific Press of July 3, I should like to tell a similar one. I was at Cobalt in 1910 and visited what is now the Seneca-Superior mine, then being operated under another name. Mr. Jackman, the manager, invited me to dinner in the combination office-and-dwelling where he 'bached.' The mining territory consisted of a tract under a lake with the customary strip of 33 ft. along the shore for buildings and shaft. The mine had never done much. After spending a fair sum of money in sinking and driving, all then disclosed was one or two little bunches of high-grade ore that scarcely served for more than samples to show to visitors. Before the company could make any money it had obligated itself to pay 25% of the ore-returns to the owners of the mining rights, and 25% more to Mr. Jackman and his partner, Mr. Segsworth of Toronto, who had sub-let the property to the mining company. The latter was financed by somebody in Rochester, N. Y. It seemed that the most one could say for the mine was that it was near the big Nipissing; a doubtful compliment at Cobalt, since a whole string of properties near real mines had proved valueless.

Later, when I was in Michigan, Mr. Segsworth wrote me explaining that the company had been re-organized, and offering me some of the new stock at a very low price per share. He enclosed blue-prints showing what had been found underground, etc., and wished me to try to interest Lake Superior people in buying some of the stock. I talked to several mining men about it, explaining that I had been at the mine, etc. One man in New York state seemed interested, and said "There might be something in this thing," but he was a friend of mine and I advised caution. Finally nothing came of it, and other things arose to divert my interest. As opposed to this do-nothing course, an engineer at Syracuse, N. Y., put all his savings into the same stock, Seneca-Superior. The mine immediately after struck it rich; the stock went up rapidly and he cleaned up a fortune.

P. B. McDonald.

Boston, June 10.

The gold-bearing areas of Turkestan have been little prospected. Gravels on several rivers are washed in a primitive manner. Dredging and hydraulicking are possible. Lode mining deserves attention. Transportation facilities are not good at present.

Manganese ore production of the United States last year was only 2635 tons, a decrease of 1413 tons. Imports totaled 283,294 tons. India, Russia, and Brazil supplied most of this.

Gypsum production of the United States in 1914 was 2,476,465 tons, a decrease of 123,043 tons. The marketed value totaled $6,895,989. New York is the largest producing state of this mineral.

Froth and Flotation

An Early Recognition of the Importance of Froth in the Flotation Process by Three Students at the University of California

In the issue for November 1903 of the *California Journal of Technology* there appeared an article describing the experimental work done on oil-flotation by three senior students in the University of California. The article is entitled 'Experiments on the Elmore Process of Oil Concentration' by W. F. Copeland, Drury Butler, and Jas. H. Wise.

At the outset they state:

"The process depends upon the fact that minerals with a metallic lustre, when treated in the form of a wetted pulp, adhere to oil, while earthy minerals do not. Two distinct operations are involved; first, the separation of the metallic mineral from the gangue by means of oil; second, the extraction of the mineral from the oil.

"The ideas underlying the first operation were patented by John Turnbridge of Newark, N. J., in 1878. In 1886 Carrie J. Everson, of Chicago, contributed the idea that the concentration was aided by the presence of an acid solution, and patented the same. But the absence of a successful method of separating the mineral from the oil prevented the practical application of these early patents. Burning the oil was tried, but this left a difficult residue to treat, and the large consumption of oil made the method too expensive. Settling the mineral out by thinning the oil with gasoline, ethers, carbon-bisulphide, etc., also proved too expensive, and it was not until July 1900 that this difficulty was overcome, when Mr. Francis E. Elmore, of Leeds, England, accomplished the separation by means of a centrifugal machine, similar in most respects to those used in sugar factories and in milk and cream separation. This contribution by Mr. Elmore, then, made the process feasible."

[They give an illustration of the plant designed by the Oil Concentration Syndicate and describe the operations. Their own apparatus is shown in photographs and they give details of the tests made on various ores. In brief, they obtained the following results:

Character of ore	Extraction %
Gold-quartz ore	86
Silver ore	75
Copper-schist tailing	90
Molybdenite ore	75

They describe the nature of their experiments and comment on the facts disclosed in a most intelligent way. We quote the salient paragraphs.]

"In making a test, the ore is first crushed to the desired fineness, and the proper charge is thoroughly wetted in the solution to be used (usually water), thus forming a thin pulp. The oil is next added and the whole charge thoroughly mixed. This mixing, or agitation, can be done in two different ways: The charge may be agitated very gently, the oil being kept in a single lake, and broken up as little as possible consistent with a thorough contact of pulp and oil; or the charge may be agitated so violently as to dash the oil up into a foam or froth, full of air bubbles; thus a very thorough contact of oil and pulp is obtained. * * * * * *

"Three methods of mixing may be used.

1. By inverting the tube several times, thus allowing the ore to fall through the oil.

2. By rotating the tube in a horizontal position, thus throwing the pulp up on to the surface of the lake of oil.

3. By violently shaking the tube, thus producing the *foam effect*,* or at least shattering the oil into small globules."

* * * * * *

"The solution used in the concentration is a matter of some importance. Water is, of course, used whenever possible, but certain other solutions have important advantages. As before stated, an acid solution is found advantageous. It cleans the metallic surfaces by dissolving the metallic oxide coatings that may have formed on them. It increases the specific gravity of the solution, and it aids in producing *the foam effect*, which is due to the generation of certain gases.

As before stated, the specific gravity of the average oil used is about 0.9 and water 1.0†, leaving a difference of about 0.1 for buoyancy or carrying capacity of the oil.

The idea at once suggests itself that if a denser solution be used, the carrying power of the oil will be increased correspondingly. A salt (NaCl) solution, for instance, gives excellent results. A saturated solution of NaCl at 20°C., containing about 27% NaCl, has a specific gravity of 1.204. This gives a difference of 0.3 between the specific gravities of the oil and of the solution, and a carrying capacity of the oil threefold greater than with water alone. Not only does it give a greater bouyancy to the oil, but *it also aids materially in producing the foam effect*, and probably aids in brightening the metallic surfaces."

* * * * * *

"As a conclusion to the above experiments, the following suggestions and inferences are appended:

1. As Regards the Wetted Pulp.—As far as could be determined, particles with either metallic or non-metallic surfaces, when in the dry state, alike adhere to the oil. Furthermore, there is no affinity of oil for water, as is shown by the fact that an oiled surface cannot be wetted. Hence if a metallic particle be thoroughly

*[The italics in all these quotations are ours.—Editor.]

†[In the original it is .1.—Editor.]

wetted, a water surface and not a metallic surface is exposed to the oil; and the former, as before stated, has no affinity for the oil. It is evident then that the water film must first be displaced before the oil and mineral can come in contact with each other. This displacement is hardly probable if the water film is in intimate contact with the particle, and it seems more probable that the differentiation is due to the fact that non-metallic surfaces are, and metallic surfaces are not, actually wetted. If this be the case, a careful study of the relative wetting of different surfaces would be an important line of investigation.

2. The ratio of the exposed surface to the weight of the particle should be as large as possible, because the total adhesive force is increased with an increase of the surface exposed to contact with the oil. This condition is best realized when the mineral breaks up into thin flakes. It is evident from this that a knowledge of the fissile character of the minerals in question is important.

3. One fundamental difficulty involved in this process is that it undertakes to concentrate and float a heavy metallic mineral, and sink the lighter gangue minerals, but this point is not necessarily fatal to the process. It is evident, however, that the heavier the gangue and the lighter and more fissile the metallic minerals, the better the ore is adapted to this method of concentration. This is a direct reversal of the ideal conditions for jig or vanner concentration.

4. Another characteristic of the proces is the fact that the ratio of concentration is usually small, due to the large amount of gangue occluded by the oil and carried into the concentrates. This difficulty is increased by sliming the gangue minerals. Sliming of the metallic minerals is no disadvantage.

Foam Effect.—*The foam effect is produced by a violent agitation, especially in acid or salt solutions. This throws the oil into a froth, which is heavily charged with air or other gases. This gas, of course, gives a greatly increased buoyant force. The oil in this condition assumes a certain load of mineral and holds it in a very stable condition. The charge does not settle and overload on standing* as in the case of the lake effect. The foam effect is best adapted for light flaky minerals, such as molybdenite.

The work above outlined suggests many lines of further investigation, and as these come to be worked out, the process will become more valuable and of more general application."

[It is clear that they had a good idea of the usefulness of the froth, and how to make it. In the employment of salt and acid, they anticipated G. D. Delprat, for his British patent for the use of salt and sulphuric acid was taken out on December 11, 1903, that is, two months after this article was published. The early work of C. V. Potter (patented on January 14, 1902) and G. D. Delprat (beginning with a patent dated November 28, 1902) did not involve the use of oil, but the generation of gas in the pulp to form bubbles. Alcide Froment (under patent dated June 4, 1902) connected the oil and bubble ideas, and it is his patent that forms the basis of the Minerals Separation process, to which in 1905 (and particularly November 6, 1906) were added several patents obtained by H. L. Sulman, H. F. K. Picard, and John Ballott, for the agitation-froth process. Thus these three students at the University of California had touched upon an idea destined to be of the greatest importance in metallurgy, but they did not know it. In the very same issue of their *Journal of Technology* there appears an article on 'The Method of Obtaining Letters Patent.' The irony of the juxtaposition is evident now. We note that the manager of this student publication was Arthur H. Halloran, then a junior in the University. He became a member of the staff of the Mining and Scientific Press after graduation and for some time after his father, J. F. Halloran, sold the control of the paper to the present writer. However, it may not be so surprising that these young fellows failed to appreciate the importance of the suggestions obtained in the course of their experimental work, but it is truly remarkable that a keen investigator like their professor, the late Samuel B. Christy, should have overlooked it, at a time, too, when he himself was at work on kindred research, more particularly in cyanidation. It may have been his absorption in the one part of the subject that prevented him from obtaining the right focus on these—now, to us—deeply suggestive experiments.—Editor.]

Removal of Selenium and Tellurium in Copper Bullion Assays

By GEO. L. HEATH

When selenium and tellurium elements are the principal impurities present in a copper bullion they may be successfully removed by a very simple scheme which takes care of the objection that these metals, under certain conditions, form compounds with silver, or copper, when reduced with sulphur dioxide.

The nitrate solution is evaporated with an excess of sulphuric acid until the dry residue is white. Dissolve in 60 cc. of water and wash into a lipped beaker, placing the tall beaker under a funnel fitted with a 3-cm. filter. Heat the solution to boiling, remove from plate, and charge with SO_2 gas for 10 min. Gas, free from chlorine, is generated by slowly dropping a saturated solution of C. P. sodium sulphite from a separatory funnel into a large round-bottom flask half filled with concentrated C. P. sulphuric acid. After settling a few hours, at least, filter into the original electrolytic beaker, and wash free from acid with hot water. Boil gently to remove most of the sulphur dioxide gas. Ignite the filter in a porcelain crucible at a red heat until the residue is oxidized, to volatilize the harmful elements.

Re-dissolve the residue in 1.5 cc. of nitric acid and add to the main solution, and electrolyze in the usual manner. A little more nitric acid and 10 c.c. of ammonia may be added, if necessary, to hold back antimony and bismuth. —*Trans.* A. I. M. E.

Notes on the Metallurgy of Zinc

By E. H. LESLIE*

During the past few months spelter has been the subject of no little discussion. While the unprecedented market conditions have given rise to much speculation as to the future of the zinc industry, the technology of the subject is also being placed under scrutiny and smelting problems are being investigated. In the past, the United States, although in the forefront of zinc-producing countries, has never held a prominent position as an exporter of spelter, the home production being but little in excess of the requirements of domestic industries, so that the foreign market offered no particular attractions to the American producer. Today conditions are changed; the domestic consumer has been forced to close his doors, in a great many instances, on account of the high cost of metal, and the European demand has advanced prices to an unprecedented figure. There is a decided shortage in retort capacity and to meet the demands of the market every effort is being made to increase the efficiency of existing plants.

In presenting these notes it is impossible, through lack of space and fear of triteness, to more than touch upon a few aspects of the subject and point to the experience of some of the representative producers who are doing their share in the development of the metallurgy of zinc. While the practice in different parts of the world varies as to cost and technical details, the information available shows a marked degree of standardization of practice and general uniformity of metallurgical results.

The ores of zinc are generally grouped under blende and calamine, the former being the sulphide and the latter including the more common carbonates and silicates. Since the price of zinc has advanced so astonishingly the smelters have refused to buy ore containing less than 40% zinc, with a preference for the ores and concentrates that are free from lead. High-grade concentrate averaging 51% and upward is in demand, while the 46% concentrate of the Australian mines and the products of lower-grade producers are finding it difficult to find a market, as under present conditions a maximum output of spelter is most desirable. The most deleterious elements, from a smelting standpoint, in ores and concentrates of zinc are lead, iron, manganese, and fluorspar. If the ore contains over 3% lead the latter is distilled in appreciable amounts with the zinc, making it an inferior commodity. The iron and manganese, if in excess, form fusible slags; hence not more than 10% of these elements is permissible in a concentrate. The fluorspar not only forms a very fusible slag, but also deteriorates the lead-lined chambers as employed in the process of sulphuric acid manufacture. The more common minerals of zinc are shown in the following table together with the loss in weight by complete calcination. Comparatively dry ore contains about 10% moisture.

Mineral and formula.	Percentage of zinc.	Percentage of loss in weight by complete calcination.
Blende, ZnS	67.2	16.4
Franklinite $(FeMnZn)O.(FeMn)_2O_3$	21.0	...
Hemimorphite, $2ZnO,SiO_2 + N_2O$	53.7	7.5
Hydrozincite, $3ZnO,CO_2 + 2H_2O$	57.1	24.7
Smithsonite, $ZnCO_3$	52.0	35.2
Willemite, $2ZnO,SiO_2$	58.1	...
Zincite, ZnO	80.3	...

	Lead, %	Iron %
American high-grade spelter contains	0.01–0.02	0.01–0.02
Vieille Montagne spelter contains	0.01–0.02	0.01–0.02
U. S. Western spelter contains	0.4 –1.0	0.02–0.05

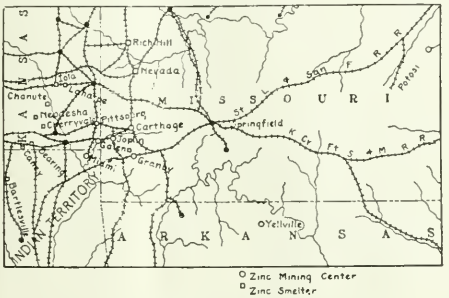
Electrolytic spelter is slightly inferior to the high-grade product. Silesian spelter contains a slightly greater amount of impurities than the U. S. Western brand.

The zinc-smelters of the United States, generally speaking, are lacking in calcining and roasting facilities. In the treatment of calamine hand-rabbled furnaces have been generally employed, and in English practice five men in 24 hours are able to calcine 20 tons of calamine, using 15.1% of Cardiff coal. The loss in weight amounts to 23% of the charge. A mechanically-rabbled reverberatory furnace in 24 hours will treat 12 tons of concentrate, using 12.4% of Cardiff coal and requiring two men per shift. The loss in weight by the mechanical method is about 28%. The mechanical furnaces therefore show a greater efficiency than those that are hand-rabbled. In European practice waste-heat from the distillation furnace is sometimes used for roasting. In treating hard calamine the fuel consumption is equivalent to 10 to 20% by weight of the charge.

Where it is not desired to use the gases from the roasting-furnaces for acid-making, the ordinary type of reverberatory is usually employed. In this connection the Zellweger, the Cappeau, and the Ropp type have found wide application. It is seldom that the gas from these furnaces contains over 2% of sulphur dioxide by volume. These types of furnaces have found wide application in Middle-West zinc-smelters. In Upper Silesia the Hasenclever furnace, which is a hand-rabbled muffle-furnace, has been used generally. Such a furnace with a hearth-area of 300 sq. ft., using 25% of the weight of the calcine of poor coal for fuel, will roast 17¼ lb. per square foot of hearth-area per 24 hours per man. The gas from this furnace ordinarily contains 7% sulphur dioxide. In the roasting operation the sulphur content

*Representative of this paper at Chicago.

is reduced from 30 to 1% with a loss of ¾% of zinc. In Westphalia the same type of furnace with a hearth-area of 325 sq. ft. will treat 17¼ lb. ore per man per day, using 15% of fuel. This type of furnace was built originally with three hearths, each having 12 doors for rabbling, and an ordinary fire-box underneath. Two furnaces are usually built in pairs with a common dividing-wall and are somewhat similar in general construction to the Hegeler furnace.* The Hegeler furnace is generally constructed with seven hearths and has a capacity of about 50 tons per day. The consumption of fuel is about 20% and the sulphur content is reduced to ½ to 1%. These furnaces are mechanically rabbled and particularly adapted to the manufacture of sulphuric acid. The Browne horseshoe furnace has a capacity of about 12 tons per 24 hours and the product contains from ½ to 1% sulphur. This type of furnace has been



SOUTH-WEST MISSOURI.

used in zinc-smelting in the United States, but at present it is not enjoying the same favor as other types of reverberatory. A great many styles of roasting furnace have been developed for use in zinc-smelting, but in large part they may be classified under the ordinary reverberatory furnace and the multiple-hearth muffle-furnace. Mechanical rabbling devices have generally replaced the hand-rabbled furnaces. This is especially true in American practice, the latter type having almost disappeared in zinc-smelting. Many modifications of the old MacDougall furnace have been developed. Among these may be mentioned the Wedge, the Herreshoff, the Hass, the Pearce, and the O'Brien. This type of furnace has been successfully used in the manufacture of sulphuric acid from pyrite, but has not found much favor with zinc metallurgists.

Various types of distillation furnaces have been developed, but all of them belong to what may be considered a type of reverberatory furnace, in which the charge is placed in enclosed muffles or retorts for the distillation of the zinc. The Belgian furnace is generally looked upon as standard and is almost universally employed. The charge is made up of roasted concentrate and fuel, which usually is mixed mechanically. The roasted blende requires from one-half to one-third its weight in fuel as a reducing agent, as does also the calcined calamine. The average charge would contain from 40 to 50% fuel and weigh 60 lb. per retort, although this varies with different types of retort and muffles. While retorts are ordinarily hand-charged, a mechanical device known as the Saeger charging-machine† has been successfully employed for this purpose, especially in Europe, where the arrangement of the furnaces in series has made it particularly adaptable.

In the operation of a distillation furnace, if conducted at a comparatively low temperature, but little lead is volatilized; but in order to get the maximum recovery it is necessary to use higher temperatures, and when the ores contain an appreciable amount of lead it often is distilled with the zinc. A typical charging mixture would be:

	Weight, lb.	Composition, %	
Roasted blende	450	Zn	65–70
Calcined calamine	410	Zn	40–50
		Pb	6– 7
Refuse	140	Ag	0.005 and gangue
Total	1000	Fe	15–18
		S	1– 1½
Coal	400	Ash	9.0
		Volatile	8.5
		Fixed C.	82.5
Residue or cinder	680	ZnS	4.0
		Zn	0.1
		PbO	1.9
		Pb	3.1
		Ag	0.006
		Fe	5.7
		FeS	2.5
		FeO,Fe_2	0.03–15.6
		C	18.1

The zinc loss in Upper Silesia when treating 25% roasted ore is 25 to 35%, while the loss at the Belgian and Rhineland plants, treating 45 to 50% roasted ore, is from 10 to 15%, which is good practice. The residue is generally about 60 to 70% of the weight of the charge and assays from 4 to 7% zinc. In treating ores containing an appreciable amount of silver it has been found profitable to re-treat this residue. The process was developed by the Jones brothers at Bartlesville.‡

The 'blue powder' produced is generally equivalent to 10 to 15% of the spelter. This oxide of zinc is usually re-charged into the retorts. In European practice 'prolongs' are generally used in conjunction with the condensers, but in American practice they have found but limited application. The object of the 'prolong,' of course, is to effect an increased saving by collecting the fume that escapes from the condensers. However, the use of these has certain objections that throw doubt on their real efficiency. Practically all the distillation furnaces today are gas-fired, using either natural gas, where it is available, as in Oklahoma and Kansas, or producer-gas, as is generally used. The direct-fired furnaces have practically disappeared, because a saving in fuel of 10 to 20% has resulted from using producer-gas, and by

*'The Rose Lake Smelter of the Granby Company,' E. H. Leslie, Mining and Scientific Press, September 12, 1914, p. 394.

†'The National Zinc Co., Bartlesville,' E. H. Leslie, Mining and Scientific Press, July 25, 1914, p. 136.

‡'Zinc Smelting at Bartlesville, Oklahoma,' E. H. Leslie, Mining and Scientific Press, July 11, 1914, p. 44.

using a regenerative furnace the saving in fuel amounts to as much as 50% over the old direct-fired furnace. While the modern distillation furnace is far from an efficient device from the thermal standpoint, it is nevertheless, a decided improvement over the old type of furnace.

The distillation process is the most expensive feature of zinc smelting, and has been the subject of no little criticism by metallurgists in other departments. However, no satisfactory substitute for the present retort-furnace has been evolved, although numerous attempts have been made in this direction. Considerable attention has been given to electrolytic recovery during recent years, but it has yet to find a recognized place in the smelting of zinc ores. Generally speaking, the cost of distillation increases as the zinc content decreases. The recovery of zinc improves as the zinc-content in the roasted ore increases, approximately as follows: a roasted concentrate containing 70% zinc on being treated in a distillation furnace under normal conditions will result in an 85% extraction of the zinc and 42% of the charge will remain as residue. Under the same conditions, a concentrate containing 50% zinc on being treated will result in an extraction of 84% of the zinc and 69% will remain as residue. The cost of distillation is a variable one, depending upon the cost and quality of the fuel, clay, labor, and supplies.

On the Continent, the following is a rough summary of the distillation practice. With a Belgian type of furnace, using concentrate + 50%, there is charged about 63 lb. per retort. With a Belgian-Silesian type of furnace, using from 40 to 50% roasted ore, there is charged about 75 lb. per retort. With the Silesian type of furnace, using 20 to 40% roasted ore, there is charged about 225 lb. per muffle.

The coal, retort, and zinc losses at various plants are shown in the following table:

Place.	Coal per ton of spelter.	Zinc loss, %	Retort loss per day, %
Vieille Montagne Angleur	3.5–4.5	15	3.5
Bergen Point, N. J.	7.4	25	7.1 (high Fe)
Passaic, N. J.	5.8	20	6.4
Lehigh Zinc, Pa.	6.2	18	3.7

In European practice the following is illustrative:

Place.	Coal per ton of roasted ore, %	Per ton of spelter, %
Upper Silesia	1.1	...
Rhineland	1.2	...
12 Belgian works	1.65	5.2
Swansea	2.45	5.81
Crown Spelter	...	5.5

Data supplied by Mr. Jones on coal consumed per ton of blende in American practice:

	Tons.
For roasting	0.25
For reducing	0.60
For gas	1.20
Total	2.05

The operation of distillation furnaces at different places, as regards the number of retorts per furnace, and retorts per man-shift, and the retorts per man-maneuver, is shown in the following table, as compiled by W. R. Ingalls:

Locality and firing.	Retorts per furnace.	Retorts per man-shift.	Retorts per man-manuever.
Kansas (direct)	224	19	28
Collinsville (direct)	256	18	26
La Salle, Ill. (producer-gas)	864	27	33
Iola, Kansas (natural gas)	620	29	36
Indiana (natural-gas)	200	26	33
Indiana (natural-gas)	424	22	30
Belgium (producer-gas)	400	22	28
Belgium (direct)	140	18	23

MAP OF OKLAHOMA.

Labor is an important item; it varies materially in different localities. Using direct-fired Belgian furnaces, in Kansas, containing 224 retorts and treating 5 tons of roasted ore per 24 hours, two furnace-men are required at $4.70 per day, two smelter-men at $3.80, four helpers at $1.40, making a total of $22.60 per day. Thus the cost of operation is from $4.52 to $4.71 per short ton. At Iola, Kansas, 21 men-shifts are to be had for $40, the two foremen get from $2.75 to $3 per day and the chargers $2.30 to $2.35 per day.

The cost of roasting and distilling, as estimated by W. R. Ingalls, is shown in the following table and will serve to give a general idea of the cost of operation in different localities.

	A.	B.	C.	D.	E.
Labor	$4.25	$4.52	$4.80	$3.20	$3.24
Fuel	0.80	1.69	0.80	3.75	3.32
Reducing	0.80	0.80	0.80	0.67	0.55
Clay	0.44	0.40	0.44	0.50	0.72
Supplies	0.20	0.20	0.20	0.20	0.20
Repairs and renewals	0.48	0.75	0.41	0.65	0.64
Administration	1.00	1.10	1.00	0.70	0.60
Totals	$7.97	$9.46	$8.45	$9.67	$9.27

A. A well-designed gas-plant (gas at 2c. per 1000 cu. ft.) using mechanical roasters.

B. Well-designed Illinois coal-gas regenerative plant using roasters. Use 2¼ tons of coal at 75c. per short ton.

C. Ordinary Kansas natural-gas plant equipped with roasters.

D. Rhineland, Germany, well-designed hand-roasters, regenerative gas-fired furnaces, coal at $2.50. Uses 1½ tons of coal per ton of ore.

E. Same plant using 1¼ tons of coal at $2.50 per ton.

Cost of distillation in Upper Silesia as summarized by Max Liebig in 1910, is shown in the following table:

	Per ton of roasted ore.
Coal at $2.86	$3.427
Flux coal at $1.90	0.857
Retorts	0.595
Condensers	0.18
Sundry materials	0.236
Tools	0.155
Repairs	0.774
Labor, superintendence, and general expense	2.678
Total	$8.90

It is apparent that these costs are exclusive of mixing and roasting. The cost of labor is said to be about 16.33 marks, which brings the total to 42.32 marks ($10.25). The recovery of zinc was 87 to 89%.

The cost of distillation in Belgium per metric ton of roasted ore as compiled by M. Guillet is as follows:

Coal at $1.95 to $2.40	$2.92 to	$3.41
Flux	0.63	0.73
Retorts	0.68	0.79
Condensers	0.24	0.29
Materials	0.18	0.27
Sundries	0.59	0.67
Total wages	4.49	5.84
Total	$9.73 to	$12.00

The cost of mixing was probably included in these figures. The recovery effected was 84.2 to 92% of zinc. The cost of roasting was not included, and was probably covered by the acid produced. These figures are compiled from the results of the operations at the Angleur, Corphalie, Engis, and Bleiberg plants.

The best practice in the United States, as conducted at two of the largest plants, is shown in the following table, which was compiled by Archibald Jones, manager of the Bartlesville Zinc Co., Bartlesville, Oklahoma.

Roasting Cost Per Short Ton of Blende Concentrate

	Natural gas.	Coal.
Labor	$0.327	$0.428
Fuel	0.852	0.956
Power	0.045	0.060
Repairs	0.116	0.130
Total	$1.34	$1.574

Smelting Costs Per Short Ton of Raw Blende

Mixing	$0.35	$0.35
Furnace labor	3.50	3.85
Fuel	2.036	4.70
Flux coal	1.73	1.73
Clay	0.035	0.035
Retorts	0.90	0.90
Condensers	0.258	0.258
Tools, repairs, etc	0.319	0.319
Total	$9.128	$12.142

The pottery department of the modern zinc smelter is of considerable economic importance and a great deal of care and experiment is devoted to producing retorts and muffles that will stand under the rigid requirements of distillation furnaces. A variety of mixtures have been compounded at various plants for the purpose, and the amount of clay used per ton of calcine treated varies considerably. The chemical analysis of the clay does not form a satisfactory guide as to its utility in the furnace, as the life of the retort is largely dependent upon the method of fabrication. A few representative retort-mixtures are as follows:

Belgium—1 part of coke, 2½ parts of burnt clay, 3½ parts raw clay, 3 parts sand.
Morriston—1 part Belgian clay, 1 part Stourbridge clay, 1 part bricks, 1 part burnt clay.
Rhineland—2 parts burnt clay, 1 part raw clay.
America—1 part burnt clay, 1 part raw clay.

The method of weathering the clay and of pugging it varies at different plants. Upon the care given to these operations depends on large part the service obtained from the retorts. With modern equipment, a hydraulic retort-press of the Mehler type has a capacity of about 250 retorts per shift of nine hours. The retorts, as they come from the press, are placed in drying-rooms that are kept at a temperature of about 110°F. There they remain about 60 days before being used. Before being used in the furnace they are placed in an annealing-oven, where they are kept for about 12 hours and given the final tempering. At some plants the retorts are given a protective coating, but this is not the general practice. The average life of a retort is 35 days.

Condensers are usually made of a composition of ½ clay and ½ crushed old retorts. The material is mixed and pugged in a small mill and subsequently molded in a condenser-machine of the Vannatti type. This machine is usually operated by two men and has a capacity of from 1000 to 1200 condensers per shift. When taken from the machine, they are allowed to stand about 24 hours and are then crimped, placed in the drying-rooms for about a week, and then burnt for use at the furnaces.

The cost of plants in various parts of the world is given in the following table:

Belgium and Rhineland	$14.50	per 2000 lb. annual capacity
Canada and United States	$17–$18	
American practice, using natural gas	$10	Per ton of annual capacity in a plant treating 25,000 tons per year.
American practice, using coal and regenerative	$16–$18	
Kansas, using natural gas	$7– $8	

Sulphuric acid works cost $5 to $6 additional per ton of ore. In Europe, roasting is generally done in a separate plant.

It will be noted that the natural-gas plants are by far the cheapest in that a great deal less equipment is required, owing to the total absence of fuel-handling apparatus, producer-gas plants, and accessories. These plants, however, are not built as permanent structures, as the fuel-supply cannot be depended upon. In determining the cost of a plant there are many important

factors to be considered, chief among which is the site of the smelter. Generally speaking, it has been found to be more economical to transport the ore and concentrate to places where cheap fuel is available; that is, where natural gas is to be found in abundance, or to the coal-fields. The present tendency in America is to build smelters in the coal regions of the East. The natural-gas supplies are uncertain and plants erected in districts dependent upon this kind of fuel are necessarily of a temporary nature.

Within the past year the zinc-smelting situation has undergone considerable change by reason of the War,

leading to the suspension of activities on the part of a great many European smelters, and the consequent increased demand on the American producers. This has resulted in a greatly increased American output, the rehabilitation of inactive furnaces, and plans for enlarged operations on the part of a great many producers. The treatment of the Broken Hill concentrate is one of the problems that has confronted the zinc smelter-men, and a movement was launched last year in London to erect a smelter in England for its treatment. While it was deemed inadvisable to proceed with this project, it is not unlikely that a plant will be erected in England to treat the Australian concentrate formerly smelted on the Continent. An estimate of the cost of treating Broken Hill zinc concentrate in Wales is shown in the following table:

Factors Used in Making Estimate of Treatment Cost

Assays:	
Zn	47%
Pb	8%
Ag	10.5 oz. per ton
Recoveries:	
Zn	85% = 40 units
Pb	60% = 48 units
Ag	50% = 5.25 oz.

Costs

Concentrate at Broken Hill, per ton	$12.66
Transportation to Europe, per ton	9.98
Lighterage at English works, per ton	0.35
Heating coal	3.05
Fluxing coal	1.83
Roasting, per ton of concentrate	1.83
Furnace labor, per ton of concentrate	3.17
Cost of plant, per ton of annual capacity, without sulphuric acid recovery	20.00
Sulphuric acid plant figures, on its own basis, assumed to effect a benefit amounting to half the cost of roasting ore, per ton	0.91
Cost of treating residue, per ton	3.05
Price of silver, per ounce (assumed)	0.49
Price of lead, per ton (assumed)	73.00
Heating coal consumption, per ton roasted ore	1.25 tons
Fluxing coal, per ton roasted ore	0.60 "

The cost of treating Broken Hill concentrate in England or Wales will be approximately as follows:

Roasting	$0.91
Furnace labor	2.92
Fuel	3.80
Flux coal	1.10
Clay and retorts	0.97
Condensers	0.16
Repairs and tools	0.28
Administration	0.12
Overhead charges, including insurance and taxes	0.37
	$10.63
Add cost of concentrate delivered at the works	22.95
	$33.58
Deduct value of the residue:	
Recovery of silver	$2.56
Recovery of lead	3.51
	$6.07
Less treatment	3.03
	3.04
Cost of ⅔ tons of spelter	$30.54
Cost per ton of spelter	$76.34

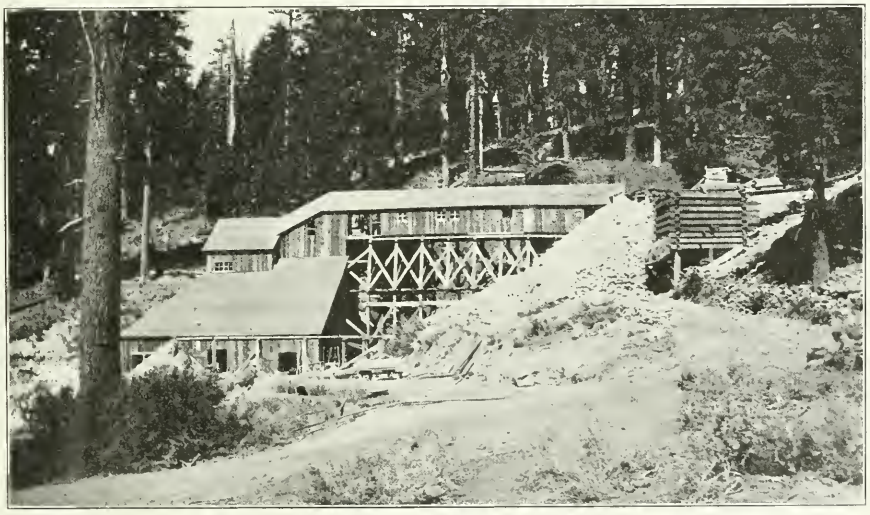
Treating 90,000 tons of concentrate per year at 40% zinc per ton, there would be about 36,000 tons of spelter recovered. At $104.67 per ton the Zinc Corporation balance-sheet shows just about an even break according to the Hirsch contract. With spelter at $104.67, and with a production cost of $76.34 the profit as per the above estimate would be the difference, or $25.93 per ton, and on 36,000 tons it would make a total of $933,480.

In presenting these notes on the metallurgy of zinc, I am indebted to numerous authorities on the subject for a great part of the statistics presented. While I have tried to give credit where due, I would ask forbearance for any oversights.

The Engels Mine and Mill

By THOMAS T. READ

Introductory. The mine and mill of the Engels Copper Mining Company, in Plumas county, California, are among the most interesting to the visiting engineer of any in the United States. The mill is the only one yet built in which no other process than flotation is used for the recovery of copper; the ore deposit exhibits unusual features, as will be described later, and it is extremely instructive to observe how, by mining skill, additional ore reserves have been found, and by the choice of the proper metallurgical method a property that labors under the disadvantage of a situation 26 miles from railroad transportation has been enabled to make a substantial operating profit.



UPPER TERMINAL OF WIRE-ROPE TRAMWAY, ENGELS MINE.

The Mine. The situation of the mining property, at an elevation of 5000 ft. above sea-level, is shown on the accompanying map. There are two groups of claims, aggregating 2800 acres. The Superior group, lying 2½ miles south of the other near a place called the Lower Camp, is as yet largely undeveloped, though the ore found in the outcrop is of higher grade than that found at the surface in the property now being exploited. During the gold rush to California prospectors made their way into this district as early as 1850. Both alluvial and lode mining for gold was done. In 1865 rich copper ore was discovered and a small smelter, which ran intermittently for four years, was built in the Genesee valley.

Copper ore was discovered here by the late Henry Engels some thirty years ago. At that time there was no railroad nearer than Reno, 150 miles away, and mining in such a remote locality was difficult, though a fair tonnage of rich ore was mined from the Superior group of claims and shipped to Swansea. The discoverer and his sons, Henry and William Engels, who have been largely responsible for the later development of the mine, were courageous and persistent, however, and the assessment work necessary to hold the property was so directed as to block out constantly increasing amounts of ore.

The building of the Western Pacific railroad through the canyon of the south fork of the Feather river, in 1909, brought main-line transportation within 26 miles of the mine, and soon after it was decided to construct a 1½-mile aerial tramway and erect a 100-ton smelter at a point at 1800 ft. lower elevation than the mine to treat the higher-grade ores. This scheme proved impracticable, as the mine is in a National Forest, and the company was restrained by an injunction from starting the smelter. Water concentration and shipment of the concentrate is not practicable, as the ore contains too much magnetite. Finally the problem was solved by the construction of a 150-ton flotation plant (now treating over 200 tons daily) that is able to make a 40% copper concentrate from a mill-feed averaging slightly less than 4% copper, the magnetite going into the tailing. Recent

development has doubled the ore reserves and the mine has at once taken a place as a property of unquestioned merit.

The Geology of the mine was studied by G. H. Garrey some years ago for the Engels Company; more recently H. W. Turner made an examination for the Minerals Separation, Ltd., which at that time had the property under option. The result of his study has been published elsewhere*: I have drawn freely on this paper in what follows. Edmund Juessen, the engineer in charge of operations, was kind enough to go with me personally through the workings and point out the significant evidence, so that it was possible to secure in two days a degree of comprehension that would have required weeks of unaided effort and I wish to express my obligation to him.

The important primary minerals in the ore are bornite and chalcopyrite, with associated magnetite. From these minerals the secondary chalcocite and covellite have been derived by upward secondary enrichment, according to the opinion of Mr. Rogers, after microscopic study. Near the surface the ore has been oxidized, chiefly to malachite, though azurite, cuprite, and native copper are also found.

Two rocks are found in the mine, a dark-green one, usually fresh, and a light-colored one that is more decomposed where so far found. The microscopic study by Mr. Rogers reveals the dark rock as a norite-diorite, varying from a fine-grained plagioclase-hypersthene variety to a coarse-grained plagioclase-hornblende rock. The light-colored rock is a grano-diorite, consisting essentially of plagioclase, microcline, quartz, and biotite, the last being variable in amount and often altered to chlorite. For convenience these two will hereafter be referred to as the basic and acid rocks. The ore occurs chiefly in the basic rock, often at a distance from the acid one; it has nowhere yet been found in the acid rock except near its contact with the basic one, and then only in subordinate amount. The microscopic study by Mr. Rogers revealed the ore minerals as later than the associated silicates, but the authors of the joint paper consider that this does not necessarily indicate a time interval of any magnitude, and that the basic and acid rocks and the ore are all differentiation products of a single magma. Since the examination on which this opinion was based exploratory work has resulted in developing double the quantity of ore then exposed and has brought to light fresh evidence that apparently points to the Scotch verdict of "not proven." It may well be true that the three products have differentiated from a single magma, but, in my opinion, the following reasons indicate that further consideration must be given to the possibility that they were in that case differentiated elsewhere and brought into their present relation separately. This would lead to the concept of the acidic rock having intruded the earlier consolidated diorite, and the formation of the orebodies as resulting in some way from this intrusion.

1. The ore is not found in the acid rock except near its contact with the basic one. In the basic rock it occurs near the contact, also along the joint-planes. It is not disseminated throughout the basic rock, which in some places contains no copper and in others exhibits fair-sized bodies of rich ore. Some explanation is necessary for the concentration of the copper minerals in ore-shoots.

2. The physical structure of the acid and basic rocks is markedly different; so much so that in most places a stranger can, after a couple of hours underground, easily perceive whether he is in the one or the other, without breaking a fresh surface, merely by the aspect of the walls. The most striking feature of the basic rock is a nearly horizontal jointing that is so prominent that a casual observer might easily suppose himself to be regarding a sedimentary rock of low dip. Other joint planes at 60° to 90° cause the face to break in a rough blocky way that is quite characteristic. The acid rock does not show this horizontal jointing, it is much more fissured by thin seams of gouge, and veinlets, in which calcite, analcite, and chlorite are present. These are regarded by Messrs. Turner and Rogers as pegmatite. It breaks to a much smoother surface. Where the two rocks are in contact the structure of one does not pass into the other, as shown in Fig. 1.

3. The acid rock is found in wedge-shaped and tongue-like bodies such as might have resulted from its intrusion into the basic rock, but which are less easy to explain as a product of segregation.

4. Where the two rocks come in contact the transition is never more gradual than might be the result of intrusion. On the other hand the relations shown in Fig. 1 can scarcely be regarded as produced by segregation.

5. Development work based on the theory that the ore-body is the product of intrusion of the acid rock into the basic ore has resulted in finding double the amount of ore previously exposed. This argument will naturally appeal most strongly to the mining engineer.

6. The neighboring Superior orebody, which I did not visit, is described by Mr. Turner as consisting of the same ore-minerals in apparently the same rocks, but occuring along joint-planes, and he states (p. 369) that the ores are distinctly later than the country-rock. While this is only collateral evidence, it indicates the necessity for exhaustive study of all the evidence now available before rejecting the hypothesis that the ore at Engels is also later than the rock in which it occurs.

It is thus seen that there are two horns to the dilemma. If these reasons for considering the hypothesis that the ore deposit is the product of intrusion of the acid rock into the basic ore are accepted, it is difficult to explain how the copper minerals could have been introduced without alteration of the silicate minerals having been produced. On page 387 of the paper quoted, Mr. Rogers states: "About the only conceivable way in which the replacement of silicates by the ore-minerals could have taken place and still leave the silicates unaltered is by means of gaseous solutions. The ore-bearing solutions

*'A magmatic copper sulphide deposit.' By H. W. Turner and A. F. Rogers, *Economic Geology*, June, 1914.

were probably rich in mineralizers." And on p. 385 he says: "Chlorite is probably a pneumatolytic mineral. It is an alteration product, but so is the hornblende." The theory of the mine foreman is that where the basic rock is coarsely crystalline and characterized by hornblende ore will be found not far off. These suggestions may perhaps serve to cover this point. On the other hand, if the magmatic segregation theory is accepted adequate explanation must be found for the phenomena noted above. To establish definitely either view further study seems necessary, and the purpose of these remarks is to stimulate discussion of this interesting phase of the subject.

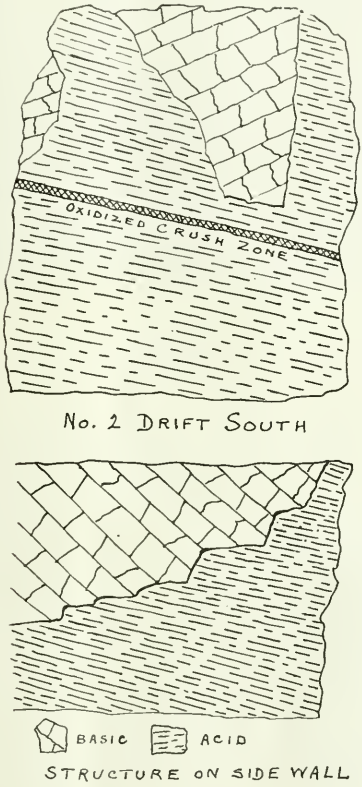


Fig. 1.

The deposit is opened by five adits and a shallow shaft. The lowest adit has a length of 1800 ft., the total length of workings being about 5000 ft. The adits have recently been connected by raises and all the ore is sent to the mill through the lowest. The ore occurs mostly in the basic rock, either paralleling the jointing of low dip, or at right angles to it. The theory of the underground foreman is that when he encounters coarsely crystalline basic rock containing a little chalcopyrite he has reached the foot-wall of the ore. This theory has proved eminently successful, for by turning off in the right direction in the old workings and driving for 15 or 20 ft. good bodies of ore have been found in a number of instances. Development work, including diamond-drilling, now in progress is uncovering considerable quantities of ore.

Near the surface a considerable quantity of oxidized ore has been found, but at present this is not useful as the oxidized copper minerals are not suitable for recovery by flotation. In the later stages of mining operations when larger quantities of oxidized material have been blocked out it may be profitable to erect a leaching plant to treat it.

The Mill, designed and built under supervision of C. B. Allen of the Minerals Separation staff, is on the hillside about 800 ft. southwest of the lowest adit. Horses are used to haul trains of 7 one-ton Koppel cars from the adit to the mill and also to haul the empty cars into the mine, as the adit was driven on a wheelbarrow grade. The cars are dumped into a storage bin of 120 tons capacity, from which it feeds over a grizzly to a No. 5 McCully gyratory crusher, crushing to 1½-in. ring. The crushed product goes to a 16-in. belt-elevator, which discharges into a 200-ton mill-bin. The ore is drawn from this by a Challenge feeder and sent through a trommel having ¾-in. holes. The oversize goes to a set of 36 by 16-in. Superior crushing rolls and the crushed product is returned by an elevator to a trommel, so that all the ore eventually passes through the trommel and thence to a pair of 36 by 16-in. Superior rolls. The crushed product from these goes to a No. 2 duplex Dorr classifier. The

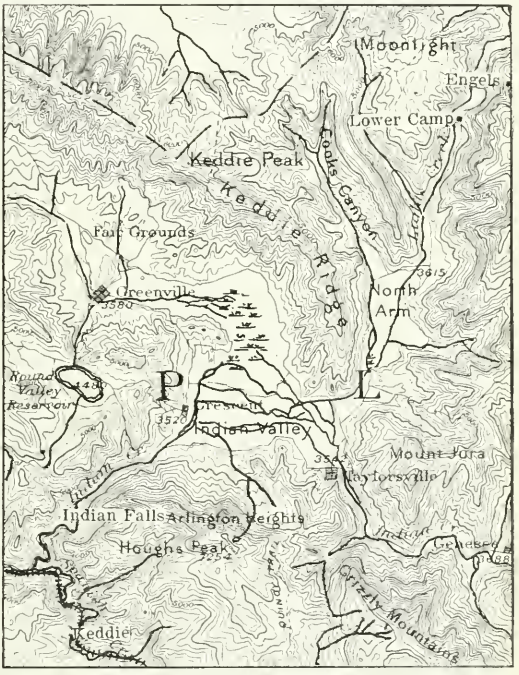


Fig. 2. Map of Engels District.

classifier feeds a 7 by 10-ft. tube-mill, which discharges into the same Dorr classifier, the amount of ore in circulation through the tube-mill amounting to 400 to 500 tons per day, so that the classifier is heavily loaded. The crushing equipment was built by the Power & Mining Machinery Co. The flotation equipment was built for the Minerals Separation Co. by Meese & Gottfried of San Francisco.

The mill-feed averages 3.8% copper and the tonnage treated amounts to 180 to 225 tons per day, depending on the hardness of the ore, as the present capacity of the mill is limited by that of the crushing and grinding machinery. The ore as mined varies a good deal in copper content and the desired average feed is maintained by sending to the bins the requisite proportions of higher and lower grade ore. As in most mines, there is more low-grade than high-grade ore available, the low-grade also being the harder. The capacity of the mill will probably be increased soon and one of the first considerations therefore will be the securing of increased crushing and grinding capacity.

The overflow from the classifier has been crushed to such a fineness that only 5% remains on 100-mesh and 65% of it will pass 150-mesh. This goes to a 12-cell standard Minerals Separation flotation machine. The oil added amounts to 0.4 lb. per ton of ore, half of which is fed to the tube-mill and the remainder to the different cells. The froth from the first three cells is drawn off as a finished concentrate. The froth from the remaining cells is returned to the first cell for re-treatment. The present total extraction averages 84%. The soluble (in dilute sulphuric acid) copper ranges from 0 to 0.4%. About two-thirds of this is recovered, the variation in the amount present leading to a corresponding variation in recovery.

The concentrate froth is sent to a settling-tank outside the building and the thickened froth then goes to an 8-ft. diam. by 6-ft. face Oliver filter, which produces a cake averaging 10 to 12% moisture. As this concentrate has to be shipped to the Garfield smelter, near Salt Lake City, it is desirable to reduce the moisture down to the point (5 or 6%) at which loss by dusting begins to occur. For this purpose an unused drag-classifier is being modified so that a fire can be built beneath it. The dried concentrate is packed into canvas sacks of convenient size to handle and loaded into the buckets of the tramway from a platform built out from the end of the mill. At the lower end of the tramway the sacks are loaded upon trailers drawn by a 75-hp. Holt caterpillar tractor. This hauls them to a transfer station at the edge of Indian valley. From this point to the railroad at Keddie the roads are better and the grades easier, and the transport is effected by Mack trucks, which, of course, travel at a much higher rate of speed than the tractor. At the railroad the sacks are emptied into railroad-cars and the concentrate sent to the Garfield smelter.

As already indicated, transportation is an important factor in the mining operations, and the making of a high-grade concentrate to reduce transport charges is an important item. The success attained by flotation is therefore partly due to the ability to make a concentrate containing 40% copper, as compared with the low-grade product made from this ore by ordinary water concentration. One of the most interesting features is the low cost of construction of the mill, amounting to less than $250 per ton of daily capacity. Through the kindness of E. H. Nutter the detailed figures are given below:

Factory cost of equipment	$22,227
Clearing millsite	101
Grading	1,847
Foundation excavations	164
Concrete aggregate	421
Contract for construction	11,800
Force account labor	244
Sundry labor	223
Sundry building material	24
Rail freight (about)	3,400
Auto trucking (about)	830
Teaming	1,461
Lumber, (148.25 M in place)	1,674
Engineering and general expense	2,716
Total cost	$47,132

Before starting operations, the following additional expenses were incurred:

Operating tools and appliances	$ 495
Operating supplies (oils, pebbles, etc.)	2731
Spare parts	251
Total	$3477

Owing to the fact that the mill equipment was shipped in mixed car-lots with other equipment for the power-plant, charges for rail-freight and auto-transport can only be approximated. The contract covered the cost of all labor employed in erecting the building, preparing the foundations, installing and adjusting all equipment, as well as the cost of corrugated iron roofing, all cement used in the foundations, building hardware, doors and windows, electric wiring material, and structural iron.

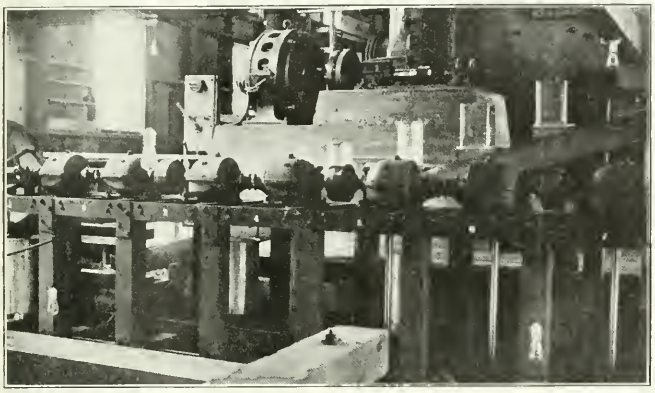
Hydro-Electric Power has been secured by diverting the waters of nearby creeks, which pass through a 4-mile flume to a power-house at the Lower Camp, 2¼ miles from the mine. Here a 485-ft. head is developed and about 450-hp. generated, which is transmitted at 2300 volts over a 10,000-ft. copper-wire transmission-line to the mine. From the middle of August until January the flow is not sufficient to generate all the power required, so two Samson distillate engines are provided for service during that period. The increasing output of the mine makes a larger and more assured source of supply necessary and arrangements have therefore been made to secure direct service from the system of the Great Western Power Co. This will furnish power sufficient for all probable future needs available at a reasonable rate, while the present plant will serve to carry peak-loads and will also provide a reserve in case of interruptions to the power service.

Working Conditions. As will have already been perceived, transportation is an important factor in operations at this property, situated as it is 26 miles from the

railroad and at an elevation of 5280 ft. Fortunately, good roads have been constructed by the county authorities and are kept constantly in repair. To within 2½ miles of the mine the grades are moderate, but in that distance the road climbs 1800 ft. The tramway handles all supplies over most of this steeper portion. I had a good opportunity to see during my visit an exhibition of the skill and ingenuity that are essential to success in all mining enterprises. The frame of an Ingersoll-Rand compressor, to provide additional air for drilling, weighing 13,000 lb., had been brought from the railroad to Lower Camp on a 5-ton Packard motor-truck, one of two that have been engaged, under contract, in hauling the concentrate that was stored earlier in the year. The truck could not proceed up the steep grade from that point to the mine, so it was necessary to transfer the heavy frame from the truck to the trailer of the tractor. The trailer was put into position directly behind the truck, and a similar truck was connected in front by a chain to aid in pulling. The chains holding the frame in position on the truck were loosened and the frame was tied to a convenient tree by a strong piece of wire rope. The two trucks were then started and, the wire rope holding the frame in position, it was gently slid from the truck to the trailer, the whole operation taking only a few minutes. The tractor ascended the steep grade without any difficulty and the frame was safely landed at the desired point.

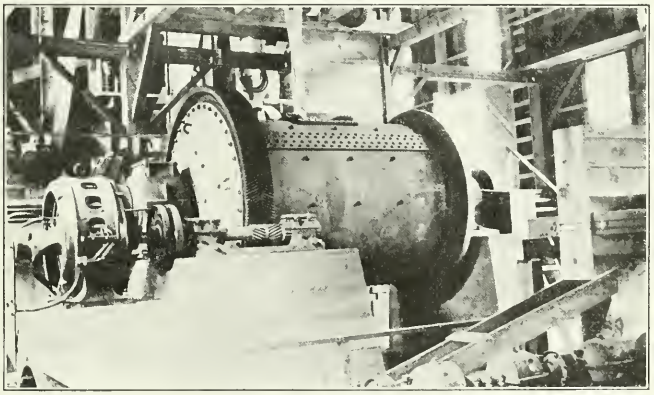
Difficulties sometimes have their bright side. During the rainy season of the early spring the roads were heavy and it was decided to store the concentrate in the smelter-bins, instead of going to the expense of having it hauled to the railroad by teams. In this way about a thousand tons of concentrate was accumulated. Meanwhile the price of copper rose so rapidly that by the time shipment was practicable the value of the concentrate had increased about $35 per ton.

Operations are hindered, as is frequently the case in mining, by the necessity for utilizing structures and arrangements already in place. The tramway connects with the adit above the present working adit, making the delivery of supplies inconvenient. This will shortly be remedied by moving the terminal to the point where the tramway crosses the track to the mill and constructing the storage warehouse and general office at this point. In designing the mill the funds available did not permit the building of storage-bins of the size otherwise desirable for equalizing operations. Underground development has not yet reached the stage where the stopes can be utilized for storage, so that work underground is unduly dependent on the daily fluctuations in the operations of the mill.

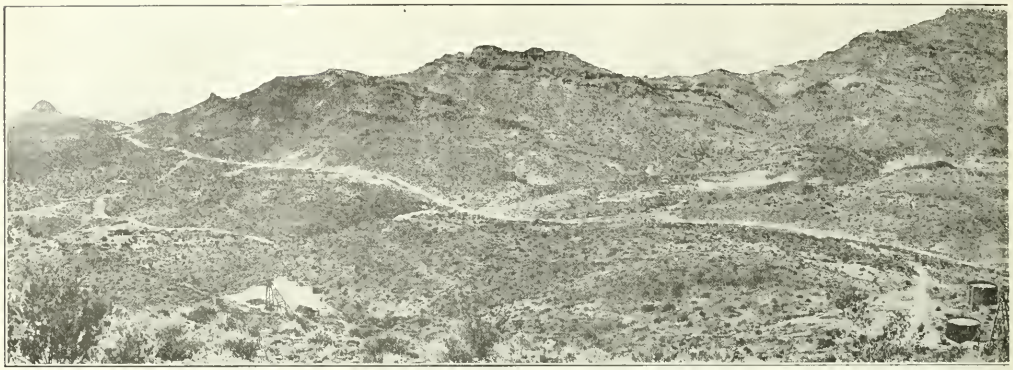


FLOTATION CELLS AND BASE OF TUBE-MILL.

There is abundant supply of timber on all the claims. Yellow and sugar pine, Douglas fir, and cedar trees of good size are at hand. A saw-mill has been erected and all the timber necessary for new construction and mine operations is sawed on the spot. As the property is in a National Forest a small stumpage charge is made for all timber cut for purposes other than the working of the mine itself. The cutting of the timber also serves to lessen the danger from forest fires. Henry Engels is president of the company, Elmer E. Paxton general manager, Edmund Juessen engineer in charge of operations, Henry Hanson mill superintendent, and John Reinmiller mine foreman. To all these gentlemen I wish to express my obligation for many courtesies.



MOTOR-DRIVEN TUBE-MILL.



United Western. Main Road to Gold Road.

PANORAMIC VIEW OF A

The Oatman District, Arizona

By HOWARD D. SMITH*

A recent mining discovery has revived interest in the Oatman district. Therefore some notes gathered during a recent short inspection may be of interest.

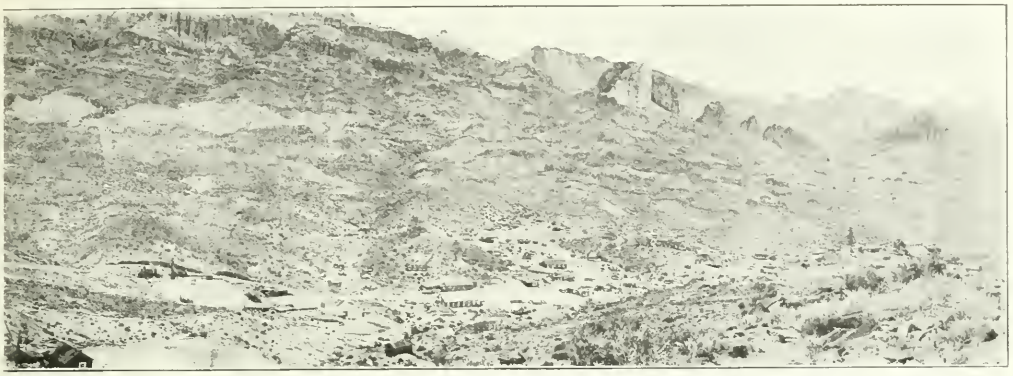
This district is situated in the Black Mountains, in Arizona, but only 20 miles north-east of Needles, in California. Passengers from the west, now that the Colorado river is low, can cross in a launch at Needles and proceed thence by regular motor-service. Heavy freight is hauled from Kingman or Topock, both in Arizona, the first named being the best railroad station for Eastern passengers. A railroad to serve the Leland property, a few miles south-west of Oatman, was constructed in 1903, but what remained after severe floods was hauled away. Even the ties are now being used for timbers in the United Eastern mine. There is little likelihood of this railroad being re-built, as all the ore produced in the district is treated locally and motor-trucks will probably prove economical for freight.

About 1863 John Moss discovered what has continued to be known since as the Moss mine at a point four miles north-west of the Gold Road mine. Some $200,000 was produced shortly after the discovery from a small hole on the surface. This showing attracted prospectors to the district. After the rush of the first-comers, little was done until 1902, when the Gold Road mine was opened up. Shortly afterward that picturesque character, Col. Thomas Ewing, promoted a number of properties. While some rich material was produced, his enterprises on the whole were not profitable. Fresh work is to be done, however, on his Victor and Virgin property, now owned by the Orion Mining & Milling Company.

*Mining Engineer, Kohl Bdg., San Francisco.

The prevailing country-rock is chloritic andesite, occurring both as intrusions and as flows, according to F. C. Schrader in U. S. Geological Survey Bulletin No. 397. This intrudes or overlies an older andesite, which in turn overlies a gneissoid granite. In the north-eastern part of the district, extending toward the Gold Road mine, the chloritic andesite is covered by undifferentiated flows of andesite, rhyolite, and other volcanic rocks. Overlying, and intrusive into the rocks heretofore mentioned, are prominent dikes of rhyolite, and finally more andesite and basalt, both as sills and dikes.

For those without the technical knowledge possessed by the geologists of the Survey, the official report, although highly interesting, is difficult of comprehension. As far as I can ascertain, the miners in the district have got little out of it except the idea that the flows of chloritic andesite would have a maximum thickness of 800 ft. and that, as the veins are not likely to be profitable in the underlying older andesite, the maximum depth for successful exploration would be 800 ft. The reported existence of $20 ore in quantity on the 1075-ft. level of the Tom Reed mine, where the collar and bottom are both in the chloritic andesite, is held to discredit Mr. Schrader. If, however, the chloritic andesite, is considered as an intrusion at this point, which is not unlikely, then this find of ore at 1075 ft. is not out of harmony with Mr. Schrader's expressed views. I hope to gain some additional knowledge at first-hand in the future, but at present I doubt whether the formation of ore-shoots can be shown to be controlled by the particular andesite serving as the wall-rock. As a constructive criticism it might be pointed out that if the learned geologists of the Survey would keep in mind the fact



United Eastern. Town of Oatman. Tom Reed.

PORTION OF THE OATMAN DISTRICT.

that they are writing such bulletins primarily for those without technical advantages, more benefit would be derived from their writings.

In general, the veins are strong, persistent, and readily followed. Some, it appears, have been traced for miles. Widths of over 20 ft. are common. Where a more complete substitution of quartz for calcite is observed, the outcrops have resisted weathering and can be seen for miles.

The prevailing strike is SE-NW, with dips at high angles NE, but occasionally SW. Veins are commonly frozen to the country-rock, and the hanging wall is usually the best defined.

The gangue consists in large measure of altered rock cemented by calcite and quartz. Schrader mentions adularia, a variety of orthoclase free from sodium, as another gangue-mineral. The ore is well oxidized. The value of the ore is due almost exclusively to its gold content. Silver is present in small proportion. According to my information the belief seems justified that more gold is found where the quartz replacement of calcite is most nearly complete. Experience in both the Tom Reed and Gold Road mines indicates that the richest orebodies are found from about the 300-ft. level down to around the 500-ft. level. Below that a marked diminution in richness is noted. While rich quartz is often found near the surface, the masses are usually small and irregular. The presence of vugs and manganese oxide in the upper portions of the veins suggests that leaching may have brought about a secondary enrichment at about the 500-ft. level in the mines.

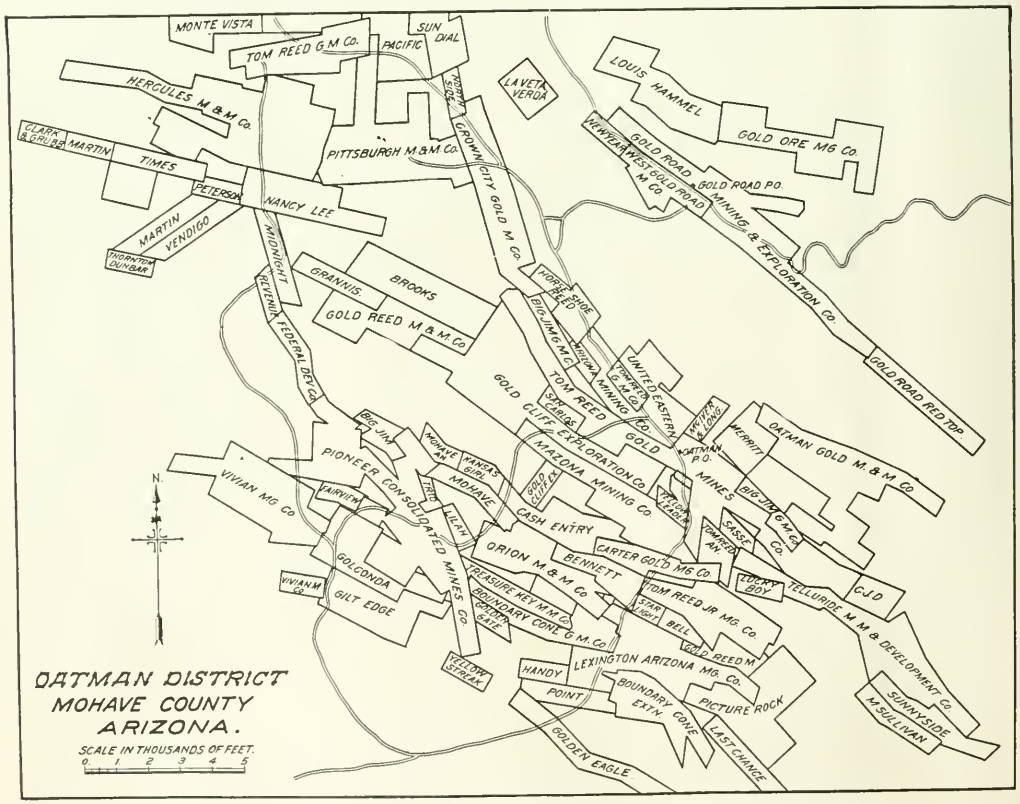
At the present time, the most interesting territory is that shown in the accompanying panoramic photograph. For some years past the Tom Reed company has operated successfully. Three ore-shoots on a vein striking 50°W and dipping 75°NE have been exposed. The workings extend north-west from the main shaft, which is now 800 ft. deep. The longest shoot in the upper levels had a pronounced rake to the north-west, but when followed by a winze about 1200 ft. north-west from the main shaft, the major axis and the north-west limit of the stopes became nearly vertical. This limit is reported to be about 240 ft. south-east of the United Eastern end-line. It may be mentioned that the Tom Reed company heretofore has pursued a policy of secrecy, at least in regard to the underground workings, no visitors being allowed access thereto. The absence of authentic information gave birth to many rumors. Messrs. Long and McIver, then working in the Tom Reed mine, became erroneously convinced, it appears, that the Tom Reed westerly ore-shoot was passing into the ground now owned by the United Eastern. They accordingly obtained an option on this ground, and started a shaft approximately 365 ft. north-west of the Tom Reed end-line. After working slowly for some time, owing to limited means the co-operation of Frank S. Keith and associates was obtained, and the shaft sunk to the 565-ft. level. According to the management, at the 307-ft. level a cross-cut shows 4 ft. of ore assaying $14 per ton; at 460 ft. a corresponding cross-cut 22 ft. long exposed ore assaying $22 per ton, and on the 565-ft. level, the vein shows 22 ft. of ore assaying $35 per ton. On the foot-wall side of the vein on the 460 and 565-ft. levels, there is, in addition, 15 to 16 ft. of material assaying about $3 per ton. On the 460-ft. level about 100 ft. of development north-west on the hanging-wall side has exposed low-grade ore, better ore being found, presumably, on the foot-wall side of the drift, as indicated in the cross-cut. Drifts 28 ft. north-west and 120 ft. south-east on the hanging wall at the 565-ft. level show an average of approximately $50 per ton for the width of the drift. Thus it appears that the concealing of information by the Tom Reed company was a powerful factor in bringing about the development of this promising property. Much difference of opinion exists as to whether the United Eastern vein, with a hanging-wall strike in the south-east drift of the 565-ft. level of approximately N 14° W and a dip 75°NE, is a continuation of the vein exploited by

the Tom Reed company, which has a strike of approximately N 50° W and a similar dip. Going N 50° W from the main shaft of the Tom Reed leads in the direction of the Oatman shaft of the Tom Reed. This, together with the information that a level follows the vein continuously between these shafts, would indicate the contrary. The course followed in the United Eastern workings thus far, provided it persists, will cause an intersection shortly with the Tom Reed workings. The use of air-drills at the United Eastern will hasten the connection suggested.

The property of the United Western is situated about a mile north-west of Oatman. W. H. Weed states that, in his opinion, this is a continuation of the deposit of the United Eastern. A shaft is being sunk a few hundred feet from the eastern boundary of the property. Extensive lateral development is proposed when the 400-ft. level is reached. Mr. Weed expresses the opinion that the geologic evidence is just as favorable for the occurrence of ore as that observed in the United Eastern. It is to be hoped that the venture here will also result favorably.

The Gold Road mine, now operated by the United States Smelting, Refining & Mining Co., is about a mile and a half north of the Tom Reed property. It is included in the Oatman district. The vein, though occurring in the undifferentiated volcanic rock overlying the chlorite andesite, is similar to the Tom Reed as regards width, extent, and character of the gangue. The gold content is lower, however. One of the orebodies cropped strongly, so that large open stopes can be seen for some distance near the No. 1 shaft. Although the metallurgical treatment is similar, namely, crushing in cyanide solutions, without amalgamation, followed by treatment in Pachuca vats and Dorr thickeners, the color of the Tom Reed tailing is much darker. This indicates a difference not apparent in the untreated ore. It is interesting to note that Dorr thickeners appear to be particularly suited to conditions in this district, where little silver is present, weak solutions are used, and slime settles quickly.

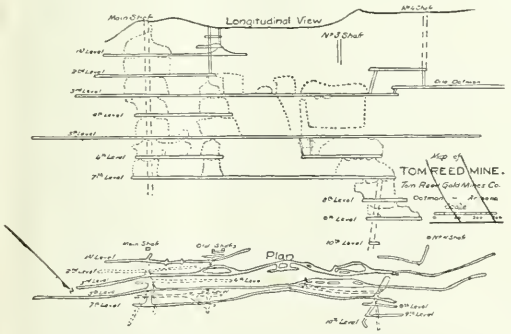
The old Moss mine, where the original discovery was made, is now to be developed under option by the owners of the Gold Road mine. A mining boom now being well under way, development is proposed and is actually being started on many other properties. Oatman itself has outgrown, almost overnight, its site in the vicinity of the mining plant of the Tom Reed property. A new town, Old Trails, located a little over a mile down the *arroyo*, is projected. A wide avenue in the dry bottom is already



MAP OF CLAIMS IN THE OATMAN DISTRICT. PREPARED BY HAFF & COLWELL, LOS ANGELES.

cleared of rocks. The district, to one familiar with boom camps, has a subdued air, particularly after dark. This quiet may be credited in part to prohibition. Let us hope that the energies formerly so prodigally wasted in dissipation will here be expended on actual work underground. A touch of human interest was given to the daily work of Oatman by the coming of Joe Parrizo with two motor-loads of relatives. He had recently received a payment for his interest in what is now the United Eastern property, and insists on having his relatives, whom he had not seen for 20 years (so the story goes) enjoy his success with him. Thus even prohibition does not wholly kill the romance of mining.

Many other properties are either doing development work, or propose to do so. No other bodies of material sufficiently valuable to justify the erection of a treatment plant are known to exist besides those already mentioned. The local slogan is "Gain depth," the inference being that this will ensure finding a mine. The United



PLAN AND SECTION OF TOM REED WORKINGS.

Eastern is instanced as conclusive evidence on this point. As against this, it may be mentioned that development on the United Eastern is at present limited, and the experience of the Tom Reed may be repeated, which followed with a stope to within fifty feet of the surface, a shoot discovered at depth. Further, there is the fact that a considerable number of shafts have been sunk, in some cases over 500 ft., without success. Inadequate lateral development therefrom is reported, however.

The problem in this district is not so much the finding of veins, as the discovery of ore-shoots in them. Nothing sufficiently tangible was brought to my attention to use as the basis for a theory to guide operators in the search for ore. That considerable areas in the veins without ore must be expected is certainly to be inferred from experiences in the Gold Road and Tom Reed mines. Consequently, sufficient capital should be provided for adequate lateral exploration before shaft-sinking is started. It remains to be proved whether the large amount of work now under way in the district will demonstrate that there are signs sufficient to make the successful search for ore something more than a fortuitous gamble.

Copy of a Contract for Tin Ores Between European Smelters and Bolivian Miners

DG
Copy.

TERMS OF SALE OF A. & C. TIN ORE FOR ACCOUNT OF MESSRS. ABELLI & Co.

The whole of the shipments of Bolivian Tin Ore to your consignment of the mark:

A. & C. A. to the extent of about 80 (eighty) tons monthly during the months of March–August, 1914, both inclusive, without guarantee of quantity.

Sellers to have the option of supplying any shortage in any month from surplus shipments in subsequent months, provided such shipments are made not later than the last months mentioned in the preceding clause. Bill of Lading date to be decisive as to the period of shipment.

The maximum quantity tenderable under this Contract is 576 (five hundred & seventy-six) tons, say 96 (ninety-six) tons per month per six months.

WEIGHING, SAMPLING, AND DELIVERY in bulk in ore-yard. Liverpool, at Sellers' expense.

TIN ASSAYS TO BE EXCHANGED by same post, to two points of decimals, and agreed between buyers and Mr. A. H. Knight, Liverpool, acting for Sellers. Should these results differ to the extent of more than half of one per cent, then either Buyers or Sellers to have the option of claiming non-agreement, and a reference sample to be sent to either Messrs. W. H. Christoe & Sons, Truro, or Messrs. F. Claudet, Ltd., London, and their result taken as final if between the results of the original assays, but if otherwise then the original assay of either Buyers or Sellers nearer thereto to be taken as the agreed assay, losers paying cost of reference.

MOISTURE LOSS to be also agreed between Buyers and Mr. A. H. Knight, on sealed bottle samples drawn at time of weighing.

TIN PRICE REGULATING THIS CONTRACT to be the Mean of the Cash and Three Months official prices of Standard Tin, as quoted by the London Metal Exchange on the market days comprised in the period of 14 (fourteen) days following the day on which each steamer bringing Ore under this Contract is reported in Liverpool Customs Bill of Entry.

Broken prices to be regulated and agreed as follows:

2s.6d.	and under	7s.6d.,	5s.
7s.6d.	" "	12s.6d.,	10s.
12s.6d.	" "	17s.6d.,	15s.
17s.6d.	" "	2s.6d.,	20s.

ORE PRICE TO BE ARRIVED AT by the agreed produce of Tin, after deduction of unitage allowance as per following scale:

74% and over	2.00	units	64% and over	3.40	units
73% " "	2.125	"	63% " "	3.55	"
72% " "	2.25	"	62% " "	3.70	"
71% " "	2.375	"	61% " "	3.85	"
70% " "	2.50	"	60% " "	4.00	"
69% " "	2.65	"	59% " "	4.15	"
68% " "	2.80	"	58% " "	4.30	"
67% " "	2.95	"	57% " "	4.45	"
66% " "	3.10	"	56% " "	4.60	"
65% " "	3.25	"	55% " "	4.75	"

being multiplied by the agreed price of Tin, and divided by 100. The result thus obtained is subject to a further Returning Charge of £6 (six pounds) per ton of Ore assaying down to 60%, plus 2s.6d. (two shillings & sixpence) for each unit below 60%, and pro rata for fractions of a unit, down to a minimum assay of 55% Tin.

PENALTY. Should Antimony, Copper, and Bismuth contents combined of any lots exceed ¼%, Sellers to allow Buyers on such lot or lots 2s.6d. (two shillings & sixpence) per ton of Ore, net dry weight for each one-tenth of one per cent of Antimony, Copper, and Bismuth combined in excess of ¼%. Total contents of Antimony, Copper, and Bismuth combined not to exceed ¾%.

STRIKES. In the event of differences with Workmen, Accidents to Machinery and interference caused by Revolution, Insurrections, or intervention of Constituted Authorities, or other contingencies beyond control of Buyers or Sellers, hindering Sellers from delivering or Buyers from receiving or smelting deliveries under this Contract shall be suspended during such time on written notice being given of such inability to deliver or receive by the Contracting Parties, when Sellers shall have the option of withdrawing any Ores so affected and disposing of them elsewhere.

FIRE INSURANCE. Should delivery not have been taken within 14 days from last day of landing at Liverpool, Fire risk to be for Buyers' account. Contract to be canceled for any material damaged by Fire within the time when the Fire risk is for Sellers' account.

SHOULD STEAMER BE LOST. Contract to be void for the portion carried by that steamer, but should the Ore, or any portion thereof be saved and come forward for Sellers' account, Contract for such portion still to hold good.

PAYMENT. Say 90% of the approximate value to be paid in London against delivery order on the day the Ore is sampled in Liverpool, and balance on settlement of assays and receipt of Invoice.

ANY DISPUTE on this Contract to be settled by arbitration, in accordance with the Rules and Regulations of the London Metal Exchange.

London, 17th March 1914.

F.W. Copy A.H.Knight,F.I.C.

Duplicate

CERTIFICATE OF ANALYSIS

ASSAY OFFICES AND LABORATORIES,
51, Highfield Street and
45, Prussia Street, Pall Mall.
LIVERPOOL, 7th February, 1914.

I herewith hand you my analysis of the average sample of Tin Ore ex *Oropesa, Bogota, Duendes.* Sampled 5/12/13 29/12/13 16/1/14

IN THE DRIED SAMPLE

A. & C.
A. 33—276 bags ex *Oropesa* 15¾ tons
" 34—276 " " *Bogota* 15¾ "
" 35—276 " " *Duendes* 15¾ "

Tin oxide	78.350
Iron	5.684
Manganese	0.022
Nickel	0.047
Copper	0.105
Bismuth	0.020
Lead	0.034
Arsenic	1.450
Titanium oxide	0.200
Tungstic acid	0.090
Silica	8.430
Sulphur	1.680
Zinc and antimony	Traces
Silver	Trace
Combined water and oxygen	3.888
	100.000

(Sgd) ALFRED H. KNIGHT.

These ores are of medium quality. They have not been roasted nor treated through magnetic separators.

THE ACCURATE DETERMINATION of radium in radium-bearing ores is generally conducted by the emanation method. With proper care the method is both certain and delicate. It is based on the fact that the gaseous disintegration product of radium, the emanation, can be completely separated from radio-active materials, and that the equilibrium quantity is proportional to the content of radium. The minute quantities of radium emanation concerned in quantitative determinations of this kind are capable of exact measurement by electrical methods, according to H. Schlundt, in *Radium*. The emanation is introduced into an air-tight electroscope or an ionization vessel connected with an electrometer, and the saturation current produced, under proper conditions, is proportional to the quantity of radium in the specimen from which the emanation was separated.

ACCIDENT RECORD at the Anaconda company's mines in the year ended March 31, 1915, was as follows: there were 1,697,814 shifts worked, during which there were 185 accidents incapacitating men from working for a period of 30 days or over. This works out at 10.896 per 100,000 underground shifts.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Three properties desirable in a wire-rope are strength, toughness, and flexibility.

Cedar blocks, on end, have been laid in a 2600-ft. sluice-box at Round Mountain, Nevada.

Three-quarters of a horse-power per ton of ore treated is all that is required at the Alaska Gastineau mill at Juneau.

A kink in a wire-rope can never be taken out. The life of a rope can be greatly lengthened by the use of a proper lubricant.

Pneumatic tools should be part of every mine equipment. So should thermit for welding, and an oxy-acetylene blow-pipe for cutting steel.

Balata, used in canvas belting, is the milky latex obtained in the same manner as rubber, by tapping trees, in the Guianas and Venezuela, South America.

Timbers framed into mitred sets with beveled surfaces are not suitable for use underground, as it is impossible to block them rigidly enough to stand the shock of blasting.

Celluloid is one of the strongest artificial materials, possessing a tensile strength of 10,000 to 12,000 lb. per square inch. It consists of a mixture or solid solution of cellulose nitrate and camphor.

Lead-wool has several advantages over cast-lead in making joints in pipes. It is more quickly placed in a joint, a fire being necessary to melt the pig-lead. On big jobs a pneumatic-hammer is best for caulking.

Electric furnaces generally use the heat of the electric current at an efficiency of 4 to 10 times the efficiency with which the heat generated by fuel is utilized, so that a comparison on the basis of thermal units is not exact.

Air-compressors make a greater output in winter than in summer. Water-jackets on air-compressors sometimes become coated with sulphate of lime from the circulating water, especially if the water gets considerably heated. By washing out the jacket with hydrochloric acid, the scale will be removed.

Zinc oxide, besides its use in paint, is employed in the making of enamels, the manufacture of rubber, the fabrication of linoleum and oil-cloth, the manufacture of printing inks, and in making toilet-powder and pharmacists's preparations. For most of these purposes oxide prepared by the French process is preferred.

Metal roofs are more easily applied and the first cost of installation is, therefore, considerably lower than that of any other type of permanent roof construction. This prevents the passage of flames from below and thus will for a considerable time retard the spread of a fire started from within.

Miners in danger are often resourceful. At Cripple Creek some time ago, John Laughlin saved his life in spite of an explosion of 86 sticks of dynamite within 20 ft. of him. He lay flat on his stomach and hung his head and shoulders down a winze while 19 holes went off. He was almost buried with rock, but extricated himself, walked to the shaft, rang for the cage, and went to the surface. He was uninjured.

Weight is often overlooked in designing a roof. This is an important advantage of tin roofs. For instance, 100 sq. ft. of IC tin laid with standing seam weighs about 65 lb. as compared with 400 lb. for wooden shingles, approximately 400 lb. for 3-ply slag, 500 lb. for 4-ply slag and 650 lb. for slate. Thus it can be readily seen that the lower cost due to lighter construction necessary in the frame-work and supporting walls to bear a sheet metal roof must be taken into consideration.

Purity of Lake copper, according to geologists, varies somewhat with the position of the lode in the series of interbedded igneous flows and conglomerates, which make up the Keweenaw series. Lodes near the base of the series seem to contain more arsenic and impurities than lodes higher up, (the dip of the Keweenaw series varies from 30 to 70°) as though the impurities had tended to settle. Another factor making for impurities in a lode is cross-veins, as in the Mohawk mine.

Mine foundries are a source of accidents. Men step into hot metal in pig molds when they are arranged on the floor; also open sand pig-beds. The turn-over mold, fitted to a stand, lessens danger from this source. To prevent any material being thrown upon a man repairing a cupola, a screen of heavy wire is suspended above him, just fitting the upper part of the furnace. A shield of sheet or cast iron, hinged to the slag-spout frame of a cupola, prevents slag from splashing over the furnacemen. Safety goggles, foundry leggings, and boots should be worn for protection against molten metal.

Sublimed sulphur is obtained by heating the crude material in hermetically sealed retorts, and condensing the vapors in large air-tight chambers. Some of the sulphur is deposited in these chambers in a finely divided state, which form is known as flowers of sulphur. The lightest and best flowers are obtained in the part of the chambers farthest away from the vapor-inlets. The proportion of this grade being small, such sulphur commands the highest price. The test of fineness in sulphur, especially of the sublimed, is its bulkiness. The more finely it is divided, the larger the space a given weight of sulphur will occupy. Flowers of sulphur should not be confused with flour sulphur.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NOME, ALASKA

Nome Today.—Automobiles, Dredges, Lode-Mining, Tungsten, Cinnabar, Platinum, and Beach-Miners.

The Nome of 1915 is not the wild and wooly mining camp of 1899 and 1900, when the second stampede of the Klondykers from up-river points and the States, rushed into the adjacent creeks and crowded Nome beach for 20 miles with every kind of mining device. The 'chechaco,' or new-comer, who arrived by steamer from the outside this spring, found a quiet municipality free from gambling-halls, hurdy-gurdys, and quasi-amusement resorts. In fact, excepting the ordinary saloons, which constitute about the only meeting-places for those who come to town for business purposes, the 'lid' is down, secure and tight. But there is a hustle and bustle of trade apparent in the open stores and on the streets that gives the Nome of today a thorough business aspect. Stores are open from 6 a.m. to 10 p.m. and why not, since it is daylight. At this time of year the sun is always visible, making almost a 24-hour day. Busy autos and delivery wagons are about all the time, and not uncommonly, even at midnight, one can see heavy freighters moving machinery, lumber, and supplies out to the mines of the interior.

DECEMBER 21 (SHORTEST DAY) AT NOME; SUNRISE, 10:25 A.M.; SUNSET, 1:35 P.M. THE WHITE SPOTS SHOW FIVE POSITIONS OF THE SUN DURING THE DAY.

The first automobile appeared at Nome in the spring of 1904, when malamutes and reindeer beat a quick retreat. Today nearly a dozen autos may be always seen 'honking' their way through Nome's busy thoroughfares. Even in winter, with dreaded blizzards and snow, we are told of 'spoony sourdoughs' who catch tom-cod and seal to take to their squaws in an automobile. The efficiency of automobiles in this region of the vast north land, like the jitneys in the States, has here been proved, having actually supplanted the Arctic and Seward Peninsula railway, which suspended all traffic in 1910. Government road-building throughout the interior has paved the way for automobiles, caterpillars, and traction-engines, while 75 miles of railroad have gone into decay and disuse.

Development of the vast resources of Seward Peninsula however, has continued and where railways have stopped other means of transportation have kept up communication between coast and interior. The output of minerals also keeps steadily growing. Evolution from the individual miners with pick and pan, long-tom and rockers, to hydraulic-mining methods marked the periods of work from 1899 to 1910. About that time, after millions had been spent in ditches and dams for water-storage, developments disclosed a condition that foretold another change, because of uncertain summer rains. Then came dredges, and today there are about 50 of these machines working in the region. Thus the gold content of a great area of virgin territory is being steadily developed.

While the change from hydraulic mining to dredging has somewhat reduced the population, as one of the boats with eight men will handle more gravel than 150 men with shovels, it is a fact that this summer there are more beach miners than any time since 1900. For 10 miles west of Nome there is a continuous line of surf-washers, long-tom operators and sluicers, all intent on making a 'grub-stake for next winter.' The faces one sees at this work along the coast both east and west from Nome, are with few exceptions, old-timers who came in years ago and failed to make their 'piles,' so the beach affords the most inducement for remuneration, and a temporary grub-stake for winter pospecting.

The next natural phase of Alaskan mining evolution is one of quartz development, which already has received a surprising impetus. For several years placer or stream tin has been produced from sluicing operations on Lost river, and the creeks adjacent to Cape York, Tin City, and tributary to Port Clarence. A recent U. S. government report cited the fact that in 11 tons of supposedly high-grade tin concentrate, there was discovered a large proportion of tungsten. Investigation later has revealed the source of these placer deposits to be in the surrounding hills which are of granitic-schist formation. The ore is wolframite, and early development of the deposits is said to be progressing favorably. From Twin Mountain, about 15 miles from Nome, come reports of scheelite placers, associated with gold.

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In the windows of Nome's leading hardware-store is displayed a ton of steel-gray graphite. This comes from the Sawtooth range about 30 miles from Nome. It is accessible only in winter by teaming over the ice.

Cinnabar deposits along the Kuskokwim river, first reported in 1904, are also receiving some attention this summer. Two outfits have gone there for systematic development. Some of the ore is rich in mercury. At Topkok, about 55 miles east of Nome, come reports of native quicksilver which is said accounts for amalgam found in virgin ground tributary to Daniels creek.

From the Kougarok river, about 70 miles north of Nome, and once the terminus of the Seward Peninsula railway, are exhibited several large samples of telluride associated with pyrite.

An immense deposit of hematite has been discovered on the plateau above the mouth of Cripple river by a former assayer of Nome. Several engineer's have examined these deposits, but their accessibility is so unfavorable that considerable road construction must be done before the ore can be transported to tide-water for shipment. The present cost of fuel and labor for reduction at the mines is almost prohibitive.

In many clean-ups of the beach-sand and gravel are found traces of platinum. No special effort has apparently been made to save this metal. Like stream-tin, the concentrate is shipped to the States without the platinum being taken into consideration. The source of this platinum is occupying the attention of at least three prospecting parties who are now in the country.

Governor J. F. A. Strong and wife visited Nome on July 7.

GOLDFIELD, NEVADA

The Silver Crown (Stimler) District Development.—New Shoot in Atlanta.—Booth, Sandstorm-Kendall, Kewanas, Great Bend.

The attention of local mining men has been attracted to the Silver Crown district, formerly known as Stimler, situated 50 miles west of Goldfield. Good-grade ore, containing gold and silver in approximately equal value, has been discovered by lessees at a depth of 75 ft. at the property of the Cottonwood Cañon Mines Co. The incline shaft of the Wheeler-Watson lease has been sunk 75 ft. on the vein and a drift has advanced 60 ft. along the footwall, in ore that has lately been yielding average assays about $80 per ton. The district has been but little prospected. Some eight years ago it was the scene of a small stampede, but the little amount of work then done was devoted to searching for high-grade gold ore near the surface. One shaft was sunk to a depth of 450 ft., but was started at the outcrop of the lode. It is a vertical shaft, and no lateral work was done. The district covers an exceedingly rough mountainside, with deep canyons and precipitous bluffs. The walls of the canyons show many veins, offering favorable opportunities for working by means of adits. Although a few locations have been made lately, a large area, containing many of these exposed veins, remains open for location. At several places in the main gulch, adits could be driven to gain depths on the veins of from 100 to 400 ft. in a short distance. There is sufficient water in this gulch for 20 stamps or more during the dryest season. The country-rocks are granite, shale, dolomite, sandstone, and some silicious porphyries. Each is present in large masses and showing little fault disturbance. The Wheeler-Watson vein is readily traced by outcrops for over eight miles, and a number of parallel veins are equally persistent in continuity. F. A. Wheeler and C. W. Watson, the lessees, are planning the early building of a mill. They have located water in the canyon, and this can be brought to the mill-site by gravity. The ore is a white, translucent, friable quartz. Tests indicate that it can be treated at low cost. There is ample wood for domestic use and excellent spring water in the canyon. The latter contains many large cottonwood trees, and piñon-pine timber for stulls can be obtained within a mile or two. The camp is 16 miles from Blair, from which point a branch railroad connects with the Southern Pacific. Some exploiting by 'wild-catters' in the early days, following the discovery, gave the district a bad name, but it now seems destined to make good.

A discovery that is regarded by A. I. D'Arcy as important, has been made on the 1660-ft. intermediate level in the Atlanta mine, and over 300 ft. south of the workings from which the main stope was opened, near the Grizzly Bear boundary. Stoping is now in progress on the new shoot, which assays from $35 to $41 per ton for the width of the drift, 5½ to 6 ft. Almost the entire metal content is gold. This ore is nearly above the point where 6 ft. of $27 ore was exposed by the first cross-cut that penetrated the vein on the 1750-ft. level. The Atlanta and Florence companies have entered into an agreement, the terms of which provide that the Florence shall work through the Atlanta workings, on the 1750-ft. level, to develop its territory, and in return the Florence will grant a side-line agreement to the Atlanta. This will benefit both companies, as it will materially reduce the overhead expense of the Atlanta and will result in important economies for the Florence.

New work has just been started at the Booth, on the 350-ft. level, to explore the vein north of the shaft, in virgin ground. ——The winze of the Sandstorm-Kendall has been sunk 100 ft. below the 500-ft. level, on the incline of the vein, and is yielding assays up to $70 gold, but no commercial body of ore has been found, the rich material appearing only in narrow seams. ——The Kewanas is developing on the 840-ft. level, where the latite-shale contact is being explored.——The Merger is making good progress in driving its east drift at a depth of 1775 ft., following the shale, and A. I. D'Arcy hopes to find the extension of the Jumbo Extension ore within the next 100 ft. A raise and cross-cut will be driven shortly to make a much-needed air connection between this drift and the 1017-ft. level of the Jumbo Extension.——Great Bend has nearly completed the unwatering of the main shaft.

LONDON

Mexican Companies and Their Troubles.—Metal Market.—Tin and Tin Geology.—St. John del Rey.

Mexican news is read with keen interest in London despite the distractions of the great war. Reports of various Mexican mining, railway, and industrial enterprises in which British capital is concerned for the past year are now being made public. They tell a uniform tale of disaster with no hope of relief except as order may be established from outside. Even the companies that have done best in Mexico, all things considered, have enough of which to complain. Santa Gertrudis has succeeded in making one shipment of bullion recently, and has got in a limited amount of supplies. The mill is, however, running at less than half-capacity, and with no certainty as to the future. La Fé has been abandoned to the Mexican staff and no reports are received at London. Buena Tierra has been unable to do much on account of lack of men and transportation. Mr. Bayliss' remarks at the meeting of June 30 may be quoted as typical: "The condition throughout the year was one of utter demoralization. During the months of January, May, and June we were to all intents and purposes dispossessed of our property, and nothing was done. In July and September we were only able to ship 284 and 393 tons, respectively, to the smelter for treatment. In four other months of the year our shipments did not reach 2000 tons; and in no instance have we been able to dispose of the 4500 tons per month which the smelter company is under contract to receive. During the whole of the period labor of any sort has been difficult to obtain and very inefficient. Transportation by rail has been suspended for long periods, and it has been impossible to secure a constant delivery of supplies to the mine; and even when we have been successful in filling our requirements, coal and other commodities have been commandeered by the Constitutional and other forces. On the top of all this the general economic condition of the country has been deplorable, and the rate of exchange has now fallen from the normal rate of two shillings (48 cents) to something like three to four pence (6 to 8c.) as the value of the Mexican dollar, and it is purely nominal at that." Despite all this the staff has stuck to the mine and has been busy developing additional ore reserves though as Mr. Bayliss says "one sometimes feels that it is useless" when it is only possible to sell in "driblets" from the 300,000 tons already waiting to be taken out. The year closed for this company with a profit of £5908 in the place of the £40,000 that might reasonably been expected under normal conditions in that any profit was shown.

The American metal market has also been watched with the greatest interest in London. The phenomenal rise in price of the principal base metals has been very disturbing to local industry. As in the United States galvanizing plants have been largely forced to suspend production because of the high

price of metal. Another and more serious factor is the shortage of skilled labor. This affects all the metal trades and industries and until recently there were even munition plants that could not be operated at capacity for want of men. Correcting this particular evil has, not unnaturally, left other trades in even worse condition for the moment. Sellers of base bullion have been notified that no more lead can be desilverized and this was one factor in the recent rise in the price. In general, it is felt locally that while there is undoubted shortage in metal, prices have been manipulated in America and, in part, with the deliberate purpose of placing the Allies at a disadvantage. The tendency towards lower levels manifest late in June was welcome. Tin is a metal that has been affected less than might have been anticipated and until substitution of one metal for another goes farther prices seem fairly stable. The local trade papers have commented severely on the fact that large contracts for tin-plate have been going to American manufacturers at prices materially lower than those of Welsh tin-plate makers. The announcement too that the A. S. & R. Co. will erect a tin smelter in New Jersey for Bolivian concentrate, has seemed to presage changes. While Straits tin is considered necessary in the manufacture of tin-plate, it is not certain that resolute experimental work would not show this to be a fallacy and at any rate the proportion of the metal used in making tin-plate is much smaller than commonly assumed, being in fact but 15% of the total production. The Cornish tin mines are in a bad way owing to the increased costs and labor shortage. It is quite possible that many will not be able to keep up production and the great war may possibly end Cornish mining on a large scale. In the Malay States tin mining has not recovered from the effects of the fall in price of last autumn. Many Chinese have gone home, leases have been abandoned, and new capital is of course unavailable. Incidentally it may be mentioned that there is a new view, or rather a return to old views, of the origin of Malayan tin. At a recent meeting of the London Geological Society, W. R. Jones of the Geological Survey of the Federated Malay States, presented the results of three years study of the Kinta valley. He totally disagrees with J. B. Scrivenor who, it will be remembered, believed the tin-bearing beds to represent ancient glacial deposits and correlated them with the Gondwana series. Mr. Jones presents strong evidence that they were in fact merely the metamorphosed and weathered equivalents of ancient phyllites and that all, in place of part of the tin, owed its origin to the nearly Cretaceous granite. His paper was accepted as conclusive by the geologists present including Watts, Tellus, and others. It seems likely that his hypothesis, which greatly limits the area of possible tin-bearing ground, will hereafter guide prospectors.

That evergreen mine, the Morro Velho, of the St. John del Rey, in Brazil, has just issued a yearly report showing that the orebody still responds handsomely to the efforts of George Chalmers and his staff of engineers. Developments on the 18th horizon, 5226 ft. vertically below the outcrop, indicate no sign of impoverishment with depth. The internal shaft 'G' has been sunk 600 ft. lower, to 5826 ft., and cross-cuts are being driven toward the lode simultaneously at 5526 and 5826 ft. Until the orebody is proved at these horizons, it is hardly permissible to say that this gold mine is 5826 ft. deep, for until that time arrives, the workings below the 5226 ft. horizon are merely the proverbial 'holes-in-the-ground.' A cheerful aspect is given to the operations by the fact that scarcity of labor no longer harasses the manager, and that it has been possible to keep the output and development at the normal level. Thus during the 12 months ended February 28, 1915 the tonnage milled was 191,500, compared with 174,000 the year before. The yield per ton remains practically constant at 47s.7d. ($11.42). Revenue was £455,927, and £64,262 was distributed as dividend, being at the rate of 10% on both preference and ordinary shares. In addition, £60,000 was transferred from profits to capital account. Many American engineers wonder that so small a proportion of the revenue is available for dividends. The chief reason for the high cost is the arrangement of internal shafts and connecting levels. This method of development was devised by Mr. Chalmers when he undertook the position of manager in 1888. Before his time the workings had collapsed and the problem of re-opening presented many difficulties. Subsequently when the workings were down to 3000 ft., the grade of the orebody fell seriously and the prospects at depth were not sufficiently hopeful to warrant large capital expenditure for the re-arrangement of the system of development. Another factor in high costs is due to the undependable nature of the walls, entailing careful rock-filling. Moreover, the nature of the ore gives metallurgical trouble, as the gangue is largely arseno-pyrite and pyrrhotite. Amalgamation is impossible and roasting too wasteful of gold. In spite of these disadvantageous conditions the recovery is as high as 93%. At the present time ore is being drawn from all the levels between 3424 and 5226 ft. The ore reserves above the latter level is sufficient to supply the mill for 3½ years. For a long time the limit of profitable or possible working at depth has been the subject of study. The immediate factor, beyond the persistence of the ore, to be taken into account is the temperature of the workings. By an elaborate system of measurement of rock-temperature, and fall in air-temperature after ventilation currents have been flowing for a short time, Mr. Chalmers is lead to expect a rock temperature of 116°F. at horizon 22, or 6426 ft. vertical, and an eventual air-temperature of 95°F. This lowering of the temperature involves the cooling and drying of the incoming air, and the subdivision of the currents so that the same air shall not pass through too many stopes in series. It should be remembered that the average temperature of the outside air during the hot season is 75°F. so that its power for cooling is small. The effectiveness of artificially cooling the incoming air appears therefore to be considerable. Altogether the St. John del Rey promises to give interesting studies relating to the limit of endurance of the miner in depth.

CRIPPLE CREEK, COLORADO

Ella W., Molly Kathleen, Vindicator, Mary McKinney, Independence.—Drainage-Tunnel.

The discovery at the Ella W. property, which was mentioned in last week's letter, continues to be the talk of the district. Six carloads have been shipped from it. In each the settlement is reported to be slightly less than $20 per ton. The boundary of the ore has not yet been found. It is said that as depth is gained the ore seems to be more solid and to carry better gold-values.

The recent excitement on Tenderfoot hill has caused considerable prospecting to be done lately in that area. On the Molly Kathleen property, which lies just southeast of the Ella W., a rich ore was recently reported at a depth of 730 ft. These two developments, so close to one another, have caused a small boom in that part of the district.

The flow of water from the portal of the Roosevelt drainage-tunnel is now 11,100 gal. per minute. As this is the largest flow recorded for several months, it would seem that the breast is approaching that ground in which a much larger area may be drained. The water in the Elkton shaft is reported to be receding so fast that sinking of the shaft may soon be resumed. At the present rate of progress the tunnel should be at the Elkton shaft in about five or six months.

Several sets of lessees on the Vindicator property are reported to be making large shipments of ore. It is of better grade than the average.

The new electric compressor and hoist recently installed at the Mary McKinney mine is about ready to start. This machinery will allow mining operations to be carried on at a depth of 2000 feet.

There is considerable activity at the Independence mine.

There are about 20 sets of lessees at work. Many of these are breaking a fair grade of ore. On company account development is steadily going on at several different points. On the tunnel-level, arrangements are being made for the installation of a storage-battery locomotive to haul the low-grade surface ores to the mill. A night shift on this level is busily engaged in replacing the old 12-lb. with new 20-lb. rails. The mill is running at full capacity on ore supplied partly from old dumps and partly from the mine.

MAZATLAN, SINALOA

Conditions at the San Luis, Candelaria, San Vicente, Estaca, Negociacion Minera, Tajo, Panuco, Los Arcos, Quiquitlan, Potrero, Bacis, and Tominil Companies' Mines.—Mazatlan.—Currency.—Bandits.—Food Supply.

In the San Dimas district, Durango, several companies have been breaking and cyaniding ore and developing right through the revolution, although all have been raided many times and held up for big 'loans' by bands belonging to the different factions. The superintendents and foreiguers have stuck to

MAP OF MEXICO.

their posts and deserve great credit for the way they have kept things going in spite of almost insurmountable difficulties in securing materials and supplies, and the constant molestation from revolutionists.

The San Luis Mining Co. at Tayoltita, treats about 100 tons of rich ore daily. Their Socavon mine is the richest in this part of the country. They have high-grade ore developed for several years.

The Candelaria Land, Mine & Power Co., at San Dimas, is working the old Candelaria mine, treating about 100 tons of mine and dump ore daily. The grade is much lower than in former years.

The San Vicente Mining Co., near San Dimas, but in Sinaloa, is mining and treating about 75 tons of medium-grade ore daily.

The Estaca Mining Co., also at San Dimas, a new company formed last year, is putting in a 10-stamp mill and cyanide plant and hydro-electric power-plant, all of which ought to be working by the end of the year.

The Negociación Minera de Guadalupe de los Reyes, owned by Spaniards, was raided in October 1913 by Maderistas under Mariano Arrieta-an *arriero*. They stole and destroyed about 75,000 pesos worth of merchandise, supplies, and bullion. The superintendent and staff (Spaniards and Mexicans) had to hide and flee to the coast. Work was suspended until May 1914. The mine is working again and the 20-stamp mill is operating at half-capacity. They are having almost constant trouble with bands of "istas" holding them up for money or supplies, and stealing their mules and horses.

The Tajo mine at Rosario is working, but not at full capacity. Work was suspended for several months in 1914.

The Panuco mine, owned by Spaniards, was confiscated about a year ago by the Carranzistas and is being worked for the good of the cause, or rather, for the benefit of a few of the chiefs. They are ruuning the mill to pieces and ruining the mine. One of the superintendents, a young Mexican, was killed a few month ago. Evidently he had been putting too much away for his own account. Another superintendent decamped with a tidy bit of bullion. I hear even their present superintendent is under suspicion.

The Butters Copala mines are in charge of a caretaker, no work has been done for a long time. Olaff Zetterlund, the superintendent of the Los Arcos company, near Copala, commenced development, but he had to leave owing to trouble from raiders. Charles Thomas sold his Palos Verdes mine near Sta. Lucia. The new owners have not been able to commence work yet owing to the unsettled state of the district. Some Los Angeles people are developing the old Quiquitlan mine, north-west of Tepic; they sent in a 5-stamp battery and a prospector's outfit last December. Some rich gold stringers are being worked by *gambucinos* on their extension of the Tigre claims. There must have been about 2000 people in there at one time last year, gophering the stringers.

E. H. Hoag is developing the Chirimoya mine in the district of Topia, in western Durango. He has a fine shoot of shipping ore.

S. K. Bradford is developing the Campanillas mine, in the Cosalá district. He has been working right along for two years, and has commenced to ship a little high-grade.

Both the Potrero Mining Co. and the Palmito Leasing Co., in the district of Mocorito, Sinaloa, have been treating ore throughout the revolution, with the exception of a few months in 1913. They had great difficulty in getting supplies and machinery to their mines.

The San José de Gracia mine, owned by Mexicans, was confiscated by the Carranzistas and is being worked by them. There is not a mine, owned by Mexicans being worked in the district. Don Herculano de la Rocha, Colonel, is on the warpath with the Carranzistas. He is owner of the rich Copalquin mines. Evidently he sided in with them to prevent the mines and other property being confiscated.

The Bacis Mining Co. was raided in May 1913. The manager and staff had to flee at night, leaving the mill running. Since then no work was done until quite recently, when they commenced to make repairs.

The Tominil (Mexican) Mining Co.'s plant and mine have been shut-down since August 1912, when there was a lot of trouble with strikers aided by Maderista soldiers. E. L. Shera has been doing a little prospecting, off and on, in the mine during past two years, but orders have been received from the directors to suspend all work until conditions improve.

Some good little mines, in the Cosalá district, owned by *casiques* were confiscated by the Carranzistas and were worked to supply fuuds for the Government, or better, the Governor. The man in charge "picked the eyes out," turned in about 25% of the bullion to the Government, and made away with the balance. He is now a Villista chief and threatens to confiscate all the claims and mines on which taxes have not been paid to the Villista government.

The Mazatlan water-works, owned by English and Spaniards, was confiscated last month and is now being operated by the Ayuntamiento for the benefit of the poor. They also threaten to confiscate the electric-light plant, which is owned by an American. Many houses, factories, and businesses, owned by

Mexicans (*casiques*) have been confiscated. One of the best residences is occupied by a Brigadier-General, formerly a charcoal peddler. In February they seized a gasoline yawl and cargo worth $7000. The boat was owned in Seattle and was flying the U. S. flag; cargo was owned by an Englishman. Owing to the efforts of the British Vice-Consul the boat was returned, but the cargo was confiscated and sold, the proceeds being distributed among a few of the leaders.

Exchange is now 20 pesos = 1 dollar. There are all sorts and conditions of filthy paper money in circulation, bills patched up with bits of newspaper, rags, wrapping paper, stuck together with wax and sewn. Those that will pass in one district are no good in another and so on.

All imported goods are extremely scarce and dear; it is almost impossible to buy them in Mazatlan or other towns. Even the ordinary Mexican food-stuffs and dry goods have gone up in price in many cases 1000% and are now almost out of reach of the poor. In many parts the people will suffer great want and actual starvation, between now and the maize harvest in November.

The bands of revolutionaries, infesting the country, are like locusts. They occupy a village, kill a few beeves, eat all the corn and beans, then move off to another village when there is no more grub in sight, and do the same there, leaving the people to suffer and starve. If the U. S. Red Cross Society is going to send food to the starving Mexicans, it ought to be very careful about the distribution or all will go to feed the lazy scoundrels who carry the guns, or enrich some of the leaders.

PORCUPINE, ONTARIO

Hollinger, Dome, Hollinger Reserve, Dome Lake, Vipond, Porcupine Crown, and Shumacher.—Kirkland Lake.

The regular gold yield of the district, active share market, and prospect of new properties being opened, combine to make a feeling of confidence in this district.

Profits at the Hollinger mine for the period ended June 17 were $125,920 against $139,187 in the previous period.

At the Dome the rich orebody cut by diamond-drilling is now being opened by drifts.

The Dominion Reduction Co. of Cobalt has taken an option on the Hollinger Reserve. Work is now under way to clean out the shaft and make the mine accessible for sampling. Considerable development was done on the property prior to closing down. A. G. Kirby, of Cobalt, represents the Dominion Reduction Co., and H. Poirer is consulting engineer.

The Dome Lake Mining Co. has asked for tenders for sinking its two shafts 100 ft. farther each. The company wishes to reach the 600-ft. level, as at this depth the ore which has been opened in the Big Dome and other properties in the vicinity seems to increase in value.

A steady production is being maintained at the Vipond. Both units of the mill worked most of the time in July. In cutting a station at 400 ft., prior to sinking to 500 ft., very rich ore was opened.

In the Kirkland Lake area important gold discoveries are reported from two miles north of Swastika, on the property of Harry Oakes. It is reported that several properties will start operations in this district as soon as they are able to secure electric power. A United States electric power company is investigating the field.

At the Porcupine Crown mine several thousand tons of old mill tailing is being re-treated. This material is from milling operations before the cyanide plant was erected. It assays about $2.50 per ton. The tailing is hand shoveled into a 1000-lb. self-dumping car, hauled up an incline-track to a storage-bin, and after mixing with cyanide solution is pumped to the tube-mill classifier, and then enters the mill-circuit with the mine ore.

Rumors are current of the discovery of rich silver ore about 50 miles north of the trans-continental railroad and 450 miles west of Cochrane. Prospecting parties are leaving here for the new district.

At the Shumacher mine, work is progressing favorably on the new cyanide plant. Continuous decantation will be used. The equipment will consist of a Hardinge ball-mill, tube-mill, Dorr classifier, thickeners, and agitators, and zinc-dust precipitation. The mill is expected to treat 150 tons per day.

MORAN, TEXAS

Wells, Production, Quality of Oil, Drilling Cost, Formation and Prospects of New Fields.

A recent investigation of some new oilfields in this state resulted briefly in the following conclusions:

In the Moran field, southeastern corner of Shackelford county, north-central Texas, the depth to oil is approximately 2000 ft.; thickness of sand 15 ft. (average) to 40 ft. maximum; largest initial production of individual well is 350 to 400 bbl.; and average production 5 to 25 bbl. per day each. The product is a paraffin base green oil of 36 to 40°B.

Eleven wells were yielding oil on June 7, totaling 400 bbl. per day. The sand is not highly saturated, consequently many of the wells make considerable water. The cost of drilling is high, due to considerable under-reaming necessary. Wells cost approximately $10 per foot to complete.

The field is spotted, dry holes being almost surrounded by producing wells. The structure is a low anticline or terrace on the general west-northwest dipping monocline. The general dip of the rocks is 40 ft. to the mile westward.

In the Strawn oilfield, southwest corner of Palo Pinto county, north-central Texas, the depth to oil-sand is 800 to 1000 ft.; thickness of sand 15 ft. (average) to 38 ft. maximum; largest initial production of individual well is about 100 bbl.; average daily production 20 to 25 bbl. each. The product is a paraffin base green oil 34 to 37°B. Twenty-six wells on June 5 gave a total of 560 bbl. per day. Oil sells at 35c. per bbl. at the well. The sand is not highly saturated. It usually contains oil at the top and water in the bottom, consequently most wells are being drilled too deep to make considerable water with oil.

Drilling conditions are good. The cost of wells in proved fields complete to 1000 ft. is not over $2000. Drilling can be contracted in the field for $1 per foot, the operator supplying fuel, water, and casing. Portable rigs are used.

The oil and gas fields in this part of Texas are small and spotted. The oil is of excellent refining grade, but the production of separate wells small, consequently the wells must be shallow, and cost little to complete if they are to 'pay out' in a reasonable time.

The oil in the Thrall field, near Taylor, is found at a depth of from 800 to 1000 ft. The initial yield of individual wells has been as high as 1000 bbl. per day. The average initial output is less than 500 bbl. per day. The cost of drilling is cheap, being shallow wells with good drilling formations. The product is a green paraffin base oil of about 40°B. of good refining grade. The unique feature of this area is the fact that the oil-sand at Taylor is really an old buried lava-flow that has been altered to what appears to be serpentine. This 'oil-sand' is probably a fragment of what was once a rather large lava-flow. This is shown by the fact that numerous dry wells drilled adjacent to the producing district have not found the sand.

That other portions of the same flow may exist in the district is probable, but there is no surface indication by which such buried fragments can be located. Consequently drilling for the same pay horizon in adjacent districts must be considered rank 'wild-catting.' Such exploitation is justified to some extent because the sand found at Thrall lies at shallow depth, is highly saturated, and the oil is of excellent quality.

THE MINING SUMMARY

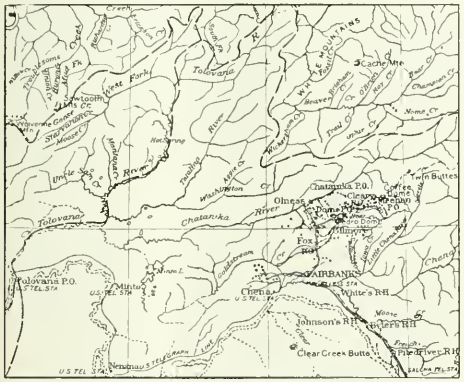
The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Fairbanks

Early in June a shortage of water was reported from all the creeks in this district, excepting Chatanika, which is supplied by a ditch from the Chatanika river. Sluicing had been suspended. Cleary, Fairbanks, Pedro, Dome, and Vault Creek mines are very short.

In Water-Supply Paper 342 of the U. S. Geological Survey, C. E. Ellsworth and R. W. Davenport discuss the surface



SOME OF THE CREEKS IN THE FAIRBANKS DISTRICT.

water supply of the Yukon-Tanana region. The work covers 343 pages, and is complete with maps and illustrations. Briefly it discusses the general features of the area, Yukon River drainage basin, and the numerous creeks.

A tube-mill is being constructed to grind tailing from the Rhoads-Hall mine. J. H. Patterson expects to make a profit in treating the dump.

ARIZONA

Metal production of this state in 1914 was as follows, according to final figures of the U. S. Geological Survey:

Cochise County

On the north vein, at No. 7 level in the Commonwealth mine at Pearce, a good shoot was cut last week. The average assay last week was $37 per ton, mainly silver. At 150 ft. in the Commonwealth Extension shaft, 30 ft. from the south side-line of the Commonwealth, 5 ft. of $25 ore is being driven on. This is encouraging for the Commonwealth.

Gila County

(Special Correspondence.)—Four furnaces have been in blast each day at the Old Dominion smelter during July. The copper output was about 50 tons per day. The old converter is still working, now over two years. The mill has averaged over 600 tons of ore per day. Pneumatic flotation is being tried. A large ore-pocket on No. 16 level was completed. It relieves the congestion on No. 15.

Interesting work is being done by McClure and Miner at their lease at the base of the Sleeping Beauty range. They are opening a conglomerate (fine-grained monzonite) well impregnated with copper. The face averages 5%, but assays have returned 8%. The deposit can be mined by open-cut. A large tonnage is available. A railroad spur has been constructed within two miles of the mine. From there the ore will go three miles to the International smelter at Miami. Fifteen men are employed, this number to be soon increased.

Miami, July 24.

Maricopa County

In *The Wickenburg Miner* of July 8 are discussed the mining areas and opportunities contiguous to Wickenburg. Until recent years mining has been confined close to the Hassayampa river, as water shortage elsewhere has retarded development. Water, found by churn-drilling has extended the field. Gold production is growing steadily, and new plants are being constructed. Copper properties are promising. Among the mines briefly described are the Grijalva, with 24,000 tons of gold ore ready for the new mill; Monte Cristo, opened to 950 ft.; Golden Eagle, a promising mine; Copper Creek district, Bagdad being the centre; Vulture, a well-known gold producer; Unida, gold-copper ore; Arizona Copper Bell mine at Constellation, Yavapai county, copper-gold; Hite gold mine in the Blue Tank district; Yavapai county; Black Rock, near the Monte Cristo, gold-silver-copper, equipped with mill, to be re-opened in October; Red Picacho Mountain gold district with some interesting mines; Hub gold mine, 12 miles from Wickenburg; the

County.	Producers.	Ore treated, short tons.	Gold,* fine ounces.	Silver,* fine ounces.	Copper, pounds.	Lead, pounds.	Zinc, pounds.	Value.
Cochise	46	1,595,385	49,084.90	2,253,953	155,420,887	9,331,116	122,304	$23,578,741
Cocouino	1	63	0.24	145	19,672	.....	.....	2,701
Gila	27	1,513,800	2,154.38	272,907	73,488,162	21,575	.....	9,970,219
Graham	3	56	0.05	203	11,838	.....	.....	1,687
Greenlee	16	1,684,481	969.68	11,711	65,558,501	.....	.....	8,745,802
Maricopa	15	39,440	26,098.94	17,960	39,583	371,468	.....	569,196
Mohave	43	204,004	91,487.48	170,845	760,678	3,718,057	9,553,050	2,719,070
Pima	33	9,657	475.38	46,782	912,652	769,145	.....	187,078
Pinal	28	2,462,459	2,873.04	178,402	60,290,636	33,234	.....	8,177,998
Santa Cruz	35	12,823	317.77	128,270	2,337,480	403,272	116,983	410,082
Yavapai	100	459,982	26,947.97	786,917	34,057,952	169,959	.....	5,528,565
Yuma	48	27,777	1,756.79	9,899	119,359	185,242	.....	64,890
	395	8,009,927	202,166.62	4,377,994	393,017,400	15,003,068	9,792,337	$59,956,029

*Includes placer production.

Constellation district with various minerals occurring in commercial quantities; Hillside mine on Boulder creek; Wonderful gold-silver-copper mine; and the property of the Monarch Mining & Smelting Co., 10 miles east of Wickenburg. Large deposits of manganese lie 30 miles west of the town. Placer mining has always attracted attention in the region. The Rich Hill gravel deposits are seven miles east of Congress Junction, Weaver district, southern Yavapai county. The district has had an interesting history. Over $2,000,000 has been recovered as course gold. Seven large quartz veins have also been developed. The place is quiet at present. All around Wickenburg are gravel areas. Southeast are the San Domingo placers of considerable extent. The Hassayampa river can supply water all the year for sluicing. Dredging has not received much attention.

MOHAVE COUNTY

The Oatman district is described on page 172 of the PRESS of this issue.

The Brattling claims, in the Silver Creek part of the Oatman district, have been acquired by the Jerome-Oatman Mining Co., composed of United Verde and other Jerome, Yavapai county, people. There is $50,000 available for development.

The Nellie Mining Co., a new concern, has taken over the Nellie claims at the south end of the district. Little work has been done by the former owner, the Pioneer Consolidated; but they are considered valuable. A 500-ft. shaft is to be sunk, and machinery installed.

West of the Nellie, F. A. Murdock has secured an interest in the E. Schotmiller property. A hoist, compressor, drills, and other plant is to be ordered.

Globe people have bought the Gold of Ophir claims adjoining the United Western mine. A deep shaft will be sunk, starting in August.

At the Chamber of Mines and Oil, Los Angeles, a good collection of Oatman ores is on view. The whole county is to be represented soon.

It is reported that Hayden, Stone & Co., of New York, are arranging to purchase shares in the United Eastern company. The mine was examined for this firm by Ralph C. Nowland.

CALIFORNIA

AMADOR COUNTY

It is reported that the Argonaut company is negotiating for the purchase of the Kennedy Extension mine, with which it had considerable litigation in 1914.

BUTTE COUNTY

After being closed for several years the Phoenix mine near Hurleton is to be re-opened. W. P. Burke is owner.

CALAVERAS COUNTY

(Special Correspondence.)—A good deal of interest is being taken in the development of the Columbia Mines property at Angels Camp, between the Utica and Melones. This company is incorporated in California, John G. Ferraris being superintendent. The mine is equipped with a 5-stamp mill, 1250 lb. each, with a capacity of 40 tons per day; also one 25-hp. gasoline hoist, a giant air-compressor, and two drills. A double-compartment shaft is about 200 ft. deep. It is intended to sink 500 ft. deeper before cross-cutting. Development of this property is being watched with keen interest by operators at Angels Camp.

Angels Camp, July 24.

On July 15 a fire destroyed eight residences and the old 40-stamp mill at the Pine Log mine at Hodson. The loss is about $8000.——At the Royal mine 125 men are employed.

At Copperopolis the Calaveras Copper Co.'s mill is treating 125 tons of ore daily, and the experimental plant 25 tons. Flotation is employed in the former. New grinding machinery is to be installed. Development is highly satisfactory. At No. 4, 5, and 6 levels the ore averages between 3 and 4%. Fifteen tons of 10% ore is shipped daily.

NEVADA COUNTY

It is reported that the South Idaho and Gold Point mines, near the Eureka, Idaho, Maryland, Brunswick, and Union Hill properties, are to be re-opened. The options taken last year on the former mentioned have been exercised by E. MacBoyle, of San Francisco.

Electrification of the Empire mine is described in the *Journal of Electricity*, San Francisco, by R. A. Balzari. The new hoist is of the double-drum type, made by Wellman-Seaver-Morgan Co. Single-reduction herringbone gear is used. The drums are 6 ft. diameter, with a capacity of 8000 ft. of rope each. The capacity is 4 tons of ore from 7500 ft. at 1200 ft. per minute. The motor is a 500-hp., 3-phase, 60-cycle, 1140-volt, 435-r.p.m. machine of Westinghouse make. It is controlled by a liquid rheostat. Several safety devices are included. The mine shaft is 5500 ft. deep, on an incline of 30°. A 3½-ton Westinghouse Baldwin locomotive hauls six 3½-ton ore-cars to the mill. Six back-geared 35-hp. motors drive ten 1360-lb. stamps each.

On July 26, the suit of the North Star Mines Co. *v.* the Empire Mines and Investment Co. commenced at San Francisco. Apex-rights is the issue. One suit asks for a perpetual injunction restraining further alleged stealing, and another asks for $15,000 damages value of the ore alleged to have been removed in the last 20 months by the defendant.

Prominent railroad men have purchased the Polar Star mine at Grass Valley.

On July 27 a skip at the Empire mine left the track, throwing out 13 men, four of whom were seriously injured. The skip stopped at 1200 feet.

PLACER COUNTY

Gravel deposits near Indian Diggings, in the southern part of the county, have been leased by the Vacinda Mining Co. to the Amador Mercantile Co. and others for $75,000 for three years. A 450-ft. adit is to be driven.

SHASTA COUNTY

Chrome-ore claims of L. H. Brown, a mile from Dunsmuir, on the Shasta-Siskiyou boundary, have been sold to C. M. Oddie, of San Francisco, for about $56,000.

SIERRA COUNTY

The Croesus company, operating the Plumbago at Alleghany, has bonded the Bigelow quartz mine at Sierra City. A good deal of work has been done on it.——At the South Fork mine the new shoot continues to show good ore.——The 10-stamp mill at the Chipps mine has started crushing after an overhaul.

SONOMA COUNTY

After being closed since shortly after the earthquake in 1906, when several men were killed, the Great Eastern quicksilver mine has been re-opened, with eight men. A furnace is in operation producing metal. It is likely that the adjoining property, the Jackson, will be absorbed by the company.

COLORADO

CLEAR CREEK COUNTY

The Capital mill continues to work full time on company and lessees' ore. Several of the latter are doing well.——The Kane adit is in 1350 ft. Connection with the Capital mine will be complete next winter.——No. 1 raise in the Onondaga mine is up 265 ft. in good ore nearly all the way. This property is worked through the Capital.

GILPIN COUNTY

A number of improvements are being made at the Bates mine. The Leasing company is shipping good ore.——C. A. Frost and others have secured control of the Brock Hollow mine, opposite the Hidden Treasure mill, at Black Hawk.——Local business men have started work at the Ingalls mine, on Quartz hill. Good ore is extracted.——Results at the Lizzie, Stewart, and Wood mines are reported satisfactory.

LAKE COUNTY (LEADVILLE)

Station-cutting proceeds at the Penrose pumping shaft. The ground above the present water-level has been drained.——The Silent Friend mine, Big Evans district, is being re-opened by W. E. Bowden and S. J. Sullivan.——A mill is being built at the Gordon-Tiger, Twin Lakes district.——The Valley adit is in 1200 ft. in promising formation.——Preparations for re-opening the Fortune mine are progressing favorably.——A new hammer type crusher has been installed at the zinc-oxide plant.

OURAY COUNTY

After a month's idleness the Wanakah smelter resumed operations on July 21. A sintering-plant has been installed. ——Rich gold ore has been opened in the Governor mine.

SUMMIT COUNTY

During the quarter ended May 31 the Tonopah Placers Co. made a profit of $63,005.

IDAHO

LEMHI COUNTY

(Special Correspondence.)—Work has been resumed at the Golden Rule mine near Salmon. The ore contains lead, copper, and gold.——The Big Dyke claims, on Kirtly creek, containing a large deposit of low-grade ore, have been purchased by G. W. Stapleton of Butte.——Placer ground in this county was last week inspected by J. H. Miles, who operates dredges at Idaho City.

Leesburg, July 18.

At the Wilbert mine the mill is producing over 600 tons of high-grade lead-silver concentrate per month. Earnings are about $12,000 monthly. Seven cars of ore recently settled for $14,783.

IDAHO COUNTY

In the PRESS of July 24 it was mentioned that ore from outlying mines in this and Clearwater counties was being shipped by parcel-post. On September 1 the post-office will add 1c. per pound, or $20 per ton, to the present rates. This extra charge will probably prohibit ore being sent after that date.

SHOSHONE COUNTY (COEUR D'ALENE)

The Pine Creek district is attracting increasing interest.——At the property of T. Brown and J. Finnel, some rich antimony ore is being opened. Shipments will be started when a cross-cut reaches the vein in deeper ground.——At the Constitution the lessees have opened an ore-shoot for 1000 ft. There is from 2 to 5 ft. of up to 40% ore showing. Ore is being shipped. This property is 10 miles from a railway.——A 50-ton mill is to be erected at the Amy and Matchless in September.——Good results are reported from the Waters Copper, Northern Light, and Palisade properties.

The Stewart company has bought 229,000 shares of the Coeur d'Alene Development Co. with F. Burbidge and C. W. Beale's shares, and now controls the concern. The property consists of 114 acres. It has been well developed, producing ore worth over $1,000,000. The mill is operated by the Stewart company.

In the condemnation suit of the Interstate-Callahan *v.* the Puritan company for a right-of-way for an aerial tramway, the defendant was awarded $4500.

The lower adit at the Gertie, Burke, is in 2890 ft. The advance is at the rate of 11 ft. per day by two drills and three shifts of miners. The main vein is expected at a vertical depth of 1440 ft. on September 10. The adit will cost about $75,000.

Ore shipments are to commence from the Hypotheek. An electric-hoist and aerial tramway are to be ordered. The main shaft is down 1140 ft. Fred Bergen is superintendent.

MICHIGAN

THE COPPER COUNTRY

All the stamp-mills in the region are being crowded with ore. More are wanted.

At the Atlas Powder Co.'s plant at Senter, a record output of powder is expected in July. In normal times it produces 900,000 lb. per month; in July 1,100,000 lb. was expected. This shows the additional ore being broken in the copper country.

A pile-driver at Lake Linden two weeks ago drove into a live wire and caused a short-circuit. This put out of commission the turbo generator supplying power for the C. & H. dredge, tailing-grinding mills, classifiers, etc. The whole plant was shut down for some weeks. The daily output of ore from the C. & H. is nearly 12,000 tons. Last week the shops started making 19,000 hollow steel one-inch drills for the machines in the mine.

The White Pine mill is treating over 800 tons of ore daily. Fine copper in the sandstone is lost during concentration, and experiments are under way to devise a process to save it.

According to the *Daily Mining Gazette* of Houghton, production of the mines for the first half of 1915 was as follows:

Mine.	Pounds.	Mine.	Pounds.
Calumet & Hecla..	43,925,000	Centennial	1,251,000
Copper Range Con.	26,608,000	Tamarack	1,191,300
Quincy	11,091,000	White Pine	980,000
Osceola Con.	10,100,000	Franklin	348,000
Ahmeek	10,881,000	Victoria	899,000
Mohawk	7,535,200	Winona	663,000
Wolverine	4,134,000	Hancock	346,400
Isle Royal	4,556,000	New Arcadian	54,800
Allouez	4,188,700	La Salle	13,000
Mass Con.	2,890,800		
Superior	2,003,200	Total	133,659,400

Production of the Lake copper district the first six months of 1915 was brought to this stage in spite of unprecedented conditions. Soon after the outbreak of War there was a general curtailment. Men were laid off and wages reduced at all properties. The smaller mines closed entirely. The larger cut production, some of them to 50%. There was loss of efficiency and value of equipment. The middle of January, however, saw a general betterment of conditions, particularly in the copper market, brought about by the metals used in fighting, and the demand of war supplies of every nature in the American markets. By the first of February the companies had commenced gradually to bring their working crews back to normal, and to increase production. By March they were practically all back at the normal, and by April all were at full capacity. March, April, and May saw enormous production at all properties. In May the wage-scale was finally restored. In June the March, April, and May productions were beaten. July will see an even larger output.

MISSOURI

JASPER COUNTY

The districts' output last week was as follows: blende, 3669 tons; calamine, 364 tons; and lead, 543 tons, averaging $93.45, $41.82, and $59.63 per ton respectively. The total value was $408,285.

A 300-ton mill is being erected on a lease of the Bakerland at Duenweg. Sheet-ore occurs at 210 feet.

MONTANA

FERGUS COUNTY

(Special Correspondence.)—Work on the new mill at the Spotted Horse mine at Maiden has commenced. With its completion the gold output of the place will be considerably increased. Development is being done on a number of properties near Maiden and the outlook is favorable.

The Gold Acres Development Co. has just been incorporated. A. S. Wright is the principal stockholder. Frank Hazen, formerly connected with the Gold Reef mine at Giltedge, now cashier of the Empire Bank and Trust Co. of Lewistown, together with J. M. Hansen and Mr. Wright will constitute the

board of directors for three months. The adit in the company's property near New Year is now in 200 ft., with 1600 ft. more to go through the mountain before the orebody is reached. The adit will enable the old tramway to the New Year mill to be used. It is planned to have the mill in operation this fall.

A part of the Kendall mine and mill in the North Moccasin mountains has been leased. The lessees are taking ore out of the old open-cut and appear to be meeting with success. The cyanide plant will make its initial run in a few days. Three leaching tanks are already filled with ore.

The Kendall Gold Mining Co. itself is doing development with a force of 25 men. A drift is being driven toward the orebody recently discovered below the 600-ft. level by the Barnes-King Development Co. in its North Moccasin mine. The shoot is supposed to extend under the Kendall property. Besides this drift, a winze is being sunk by the company. The Kendall mine and mill have been closed for over two years, until work was started this summer.

Lewistown, July 19.

Missoula County

The mine, mill, and power-plant of the Iron Mountain Mining Co., three miles north of Superior, were purchased at sheriff's sale on July 17 at Missoula by the Federal Mining & Smelting Co., for $110,000, one-tenth down and the remainder to be paid on the delivery of the deeds. The Iron Mountain company has paid over $500,000 in dividends. It was opened 14 years ago, and has been worked eight years. It has a 250-ton mill, complete power-plant, and 11 miles of transmission-line. The mine will ship over the Coeur d'Alene branch of the Northern Pacific. The closing of the producer several years ago was the result of the law in Montana requiring every mine to have two openings. The mine complied with this regulation later by driving an adit more than a mile long on the 1500-ft. level.

NEVADA

Esmeralda County

(Special Correspondence.)—Never before have shipments of ore been so regular from this district. The Western Ore Purchasing Co. is working double shift and sampling six carloads daily, totaling 250 tons. Last month the sampler dispatched 5000 tons, and July will probably show a 50% increase. There is no indication of a falling off in the supply, on the contrary, there is every reason to look forward to a large gain. Last Monday the regular freight-train on the Tonopah & Goldfield railroad consisted of sixteen 50-ton cars of ore going to the smelter. This looks like big work and is an important factor in establishing the prosperity of Goldfield. The Las Vegas & Tonopah line is also carrying a considerable tonnage direct to the smelters around Salt Lake City. Regular contributors to the outgoing tonnage are Jumbo Extension, Atlanta, Red Top lessees, Florence, and the Consolidated. It is not generally known that a lease which ranks with the premier producers of pioneer days is steadily operating here with a gross production of approximately $100,000 per month. In June the Red Top lessees produced $132,000 of ore.

Goldfield, July 22.

The Phelan lease vein at 500 ft. in the Silver Pick is shown to be 16 ft. wide in the cross-cut. It is low-grade. North and south drifts are being driven on the vein. The water problem is being handled successfully.

Final figures of the Goldfield Consolidated for June are as follows: ore treated, 32,224 tons; net profit, $142,120; net cost, $5.28 per ton; development done, 2638 ft.; cost, $6.39 per ft.; and lessees produced 515 tons of ore with a gross value of $13,068, from which the company received $6543, less the cost of milling and transportation. A dividend, No. 23, of 10c. per share, was distributed last week. The second quarter of 1915 resulted as follows: ore treated, 95,358 tons; gold yield, $962,224; and profit, $456,910.

Humboldt County

The Rochester Mines Co. has purchased the Four J lease, in which 20,000 tons of good ore has been opened. This lease got its name from four men whose first initials were J. The mill is treating 100 tons of $15 ore per day with good recovery. It has produced $130,000 since starting in April.

In slightly over two years over 15,000 ft. of work has been done in the Rochester Mines property, exclusive of stoping. The output was over $800,000 down to 300 ft. Present workings

SILVER BULLION FROM THE NEW ROCHESTER MILL.

have opened ore for 3000 ft. The winze from 300 ft. in the Big Four is down 90 ft. This is 810 ft. above where the Friedman adit will cut the ore at a vertical depth. The vein in the winze is 7 ft. wide, with $19 per ton gold and 40 oz. silver.

A report of the Seven Troughs Coalition for the quarter ended June 30, 1915, states that 1120 tons of ore yielded an average of $84.40 per ton, a total of $94,513. Amalgamation recovered 91.65%, and concentration, 3.12%. Adding cash on hand there was $171,621 available. Operations cost $54,725, and No. 3 dividend, $36,076. The balance is $123,706. Development to 1400 ft. totaled 854 ft. Rich ore at 1200 ft. south continued toward the end of May, when the vein pinched with valueless material. The drift now shows 6 in. of $10 to $15 ore. Good ore should soon be opened again. At 1300 ft. south the drift is in the shoot 50 ft., it being from 15 to 48 in. wide. Two feet in the face assays $59.20 per ton. On June 30 samples from the stope returned from $113.60 to $326.40 per ton. At 1400 ft. the last sample gave $98.40 from 20 in. A good deal of new equipment has been added.

The National mining district, of which little is heard, has recently been described by Waldemar Lindgren in Bulletin 601 of the U. S. Geological Survey. From 1908 to 1912 one ore-shoot produced about $4,000,000. The mineral deposits of the Santa Rosa range, where the mines are situated, like those of many other parts of Nevada, may be divided into two principal classes, younger gold and silver-bearing veins that occur in or near the Tertiary volcanic rocks, and much older gold and silver-bearing veins that occur in sedimentary and associated granitic rocks. In this area the older deposits are but poorly represented, and have yielded only a small output; but one of the younger or Tertiary veins has locally been wonderfully rich, yielding much ore averaging $30 per pound. During the early period of activity a few thousand tons of low-grade ore, assaying about $100 per ton, was thrown on the dump of the National mine, but the ore shipped averaged about $30,000 per ton in gold having a value of $10.60 an ounce, the remainder being silver. The veins are inclosed in latite, rhyolite, basalt, basalt tuff, and trachyte. They consist of sheared rock a few feet wide traversed by quartz seams containing stibnite, pyrite, chalcopyrite, arsenopyrite, zinc-blende, and galena. Cinnabar was found in one of the veins. Most of the veins that carry much stibnite are poor in gold and silver. Native gold is found principally in the rich shoot of the Na-

tional vein the isolated position of which, in a district of quartz-stibnite veins poor in gold and silver, is remarkable. The several veins appear to belong to one and the same epoch of mineralization, the gold shoot being a local development upon one of the normal stibnite veins. The gold shoot was encountered 40 ft. below the surface. It has been followed on the dip of the vein for 800 ft., the stope length being 250 ft. The ore, which yielded $20 to $30 to the pound, occurred mostly in an irregular footwall seam from a few inches to a foot wide.

Mineral County

The Azurite copper claims in the Hawthorne and Mina districts were bought at a forced sale by H. Geile of Grand Rapids, Michigan, for $30,000. The Azurite Mining Co.'s debts were $63,000. The mines contain rich ore. Sinking is to be continued to open sulphide ore.

Nye County

Companies and lessees at Tonopah last week produced 11,137 tons of ore worth $226,426.——Bullion and concentrate from the Belmont for the first half of July totaled $142,000. Work has been resumed at several old faces at 800 ft.——At 1260 ft. in the Extension the shoot is 300 ft. long, averaging 12 ft. in width.——The report of the Tonopah Mining Co. for the quarter ended May 31 shows that the gross value of the ore milled was $491,483. The net profit was $229,399. Quick assets total $1,532,964. On account of low prices of silver the next dividend will be reduced.——The West End report for the year ended December 31, 1914, has been published, and will be discussed in another issue of the Press.

White Pine County

The Nevada Consolidated *Safety First* for June has on its cover an X-ray of a fractured index finger, usually an index of a fractured safety rule. Extraordinary accidents included one trouble from snake-bite, and another from fist-fight injuries. At the Ruth mine a cave-in killed a miner, and seriously injured another. At Copper Flat there were eight disabling accidents. Injuries at the mill and smelter were not very serious. At all works there were 21 accidents causing loss of time of 158 days.

NEW YORK

St. Lawrence County

A new zinc-mining district is being developed in the northern part of this state at Edwards, near Gouverneur. The ore, unusually rich, is blende mixed with pyrite, making separation difficult.

OREGON

Forty potash claims along Succor creek, have been purchased by the American Nitrate Co. of Oregon for $100,000. G. D. Huntley of Boise, Idaho, had a large interest in the property.

TEXAS

Culberson County

(Special Correspondence.)—There is much activity in prospecting and development of copper properties in the Van Horn district of western Texas.——In the vicinity of Allamore it is stated that several claims are being opened with satisfactory results. Martin Jarrell is making regular shipments of copper ore from his property in that area to the smelter at El Paso.——In the same district J. L. Johnson is preparing to begin shipping ore from his mine to the smelter.——The Copperplate Mining Co. has been organized by a syndicate of South Dakota men for the purpose of re-opening and developing on an extensive scale the old Copperplate mines, situated six miles from Van Horn. The company has its headquarters at Van Horn. It is stated that it will install machinery and place the property on a producing basis as quickly as possible. The ore also contains gold.——The Sutton Steel Co. of Dallas has taken over the Hazel mine, in the Van Horn district, and is preparing to unwater it. This mine has a splendid record as a producer of large quantities of low-grade copper ore. There are about 5000 tons of low-grade ore on the dump, and the company plans to install a mill to treat it.——J. H. Searles, of Chicago, and associates have acquired a large tract of land in the Terlingua cinnabar district of this county. It is stated that a number of outcrops of cinnabar are found upon the property. It has been decided to open these ore deposits, and to install a quicksilver furnace when the development work has made sufficient progress to justify the improvement.

Alpine, July 1.

Texas has produced during the first six months of 1915 approximately 260,000 oz. silver, 70,000 lb. lead, and 100,000 lb. of zinc. This indicates an increase in silver. These figures are included in the mid-year statement of the U. S. Geological Survey, and are based upon the report of C. W. Henderson.

UTAH

Juab County

The Tintic district shipped 193 cars of ore last week.——On August 5 the Eagle & Blue Bell will distribute 10c. per share, equal to $90,000.

Salt Lake County

Wages of about 7000 miners, mill, and smelter-men working in the neighborhood of Bingham and Salt Lake City will be increased on August 1. The increase is based on copper at 17c., and lead at 5.25c. per pound. Salaried employees get a 10% rise; skilled men earning $2.75 per day or over, 25c.; and unskilled men getting less than $2.50, 20c. Wages per shift will be as follows: machine-men, $3.50; machine-helpers, $3.25; steel miners, $3 to $3.25; maximum wages to apply only to skilled miners; timber-men and timber-men helpers increased 25c., with maximum for timber-men of $3.50; hand-trammers, $3; horse and mule-trammers, $3.25; horse and mule-trammers' helpers, $3; and nippers, $3.

A large ventilating fan is being installed at the Alta Tunnel & Transportation Co.'s tunnel, which is in 1320 ft. The Karns drilling machine, weighing 5200 lb., operated by two men, is extending the adit about 15 ft. per day. It is proposed to drive the adit 13,000 ft. to drain the Big Cottonwood mines.

CANADA

British Columbia

During July the Standard Silver-Lead company at Silverton shipped about 1500 tons of concentrate, worth $90,000, to the Trail smelter. Dividends are to be resumed in September, after a year's lapse.

Ontario

During the month ended June 17 the Hollinger produced 24,192 tons of ore averaging $9.23 per ton. The profit was $125,921. The monthly dividend of $120,000 left a balance of $5921. The surplus is $1,270,014.

According to the manager's report of the Dome mine crosscut 607 is finished. The vein is 65 ft. wide, averaging $21.43 per ton. Cross-cut 608 is being driven on the course of diamond-drill hole No. 53, which showed the vein to be 153 ft. wide, with ore averaging $14.48. This drill-hole has been followed with the cross-cut for 35 ft. and the ore averaged $19. The best ore is still ahead. Drift 609 going east along the contact of the porphyry dike is still in high-grade ore. An effort is being made to start the diamond-drills again to cut this rich orebody at different points. The manager expects to add greatly to the amount of high-grade ore already blocked out. This now amounts to 375,000 tons. He states that if for safety he cuts down his estimate of value of this ore to only $15 per ton, there has been added lately about $5,625,000 to the ore reserves.

The annual report of the Temiskaming company states that

development totaled 2805 ft. A Nordberg hoist with capacity for over 1600 ft. depth has been ordered. Deep exploration will be continued to that depth when the engine is erected.

KOREA

In June the Oriental Consolidated produced $136,500. Details of the May return are as follows: ore treated, 26,483 tons; yield from all plants, $154,231; the Candlestick mill started on May 15; 40 stamps at the Maibong are now dropping; extraction at the Maibong tube-mill was 85.6%, and with slag, 88 or 89%; and recovery at the Taracol cyanide plant 93.6%. There are 20 Korean 10-stamp mills working at Kuk San Dong. The tributers are working various stringers and pillars, and are paying the company a fixed mill rent. The company also buys the gold they produce.

MEXICO

Sonora

New currency worth ₱4,000,000 is to be issued on August 1 by Governor Maytorena, on the basis of ₱2 or ₱3 for $1 U. S. gold. So far he has had little success with the money. Two methods of disposition are to be tried: that the Cananea Consolidated finance the issue, the export and import duties of the company being deposited as a guarantee of the redemption of the issue at a rate of ₱2 for $1 gold. It is understood that the governor will insist on the company buying the new issue for use in paying its employees, abandoning the present system of paying in silver. Since the resumption of operations, the company has been paying in silver, which the workers can exchange at a rate of from ₱12 to ₱15 paper money for ₱1 in silver.

The other proposal is that the Maytorena government deposit the anticipated duties on the garvanzo (a grain) crop, which, according to estimate, will be approximately $1,800,000 gold. With this duty as a reserve for the paper money issue, the bills, according to the Maytorena party, could be circulated with a value of 33⅓c. gold. In this case the American mining companies in Maytorena territory would be compelled to buy the scrip from the Government for the payment of wages and all duties and taxes, Maytorena thus forcibly creating the demand for his new billets, according to the *Douglas Daily Dispatch*. Inability of the Governor to secure exportation of the garvanzo crop, on account of destroyed railroads, the blockaded port of Guaymas, or the cutting off of communication from south of Guaymas to the border, by the activity of either General Calles or the Indians, would result in failure of the plan. Already the American mining companies have been approached in order to ascertain what amount of the ₱4,000,000 they can be expected to take at an inflated value. Border banks also have been sounded, with results disappointing to the Maytorena faction. The new currency is of good appearance, made by the American Bank Note Company.

On account of a shortage of fuel the Moctezuma Copper Co.'s mine and mill were closed on July 15. When the railroad reopens, within about a month, work will be resumed.

The output of Greene-Cananea in July is estimated to be 3,000,000 lb. copper. Part of the mill is working. Two reverberatory, and four blast-furnaces, and three converters are in operation.

PHILIPPINE ISLANDS

Press Bulletin No. 43, dated June 15, describes the copper deposits in the Zanbales province. These have attracted attention as the known commercial deposits are in the Macayan district, Mountain province. The country is very rugged, and the rivers show the formations well. Most of the country is a porphyritic-andesite, considerably broken up. Quartz veins fill the crevices, and dikes cut the andesite. The copper occurs in small veins and masses which fill fissures and cavities of the fractured andesite. Metallic copper is found. Assays show traces of gold and silver. Several properties are described. Several mining men are disappointed with the deposits.

PERSONAL

Leon J. Pepperberg is at Portland, Oregon.

J. H. MacKenzie has returned from Juneau.

Donald Greene is here from Phoenix, Arizona.

J. W. Mercer is in Tuolumne county, California.

G. W. Wood, of Denver, was here during the week.

Francis Drake left London for Rhodesia on July 28.

Albert Burch has gone to Denver, on his way to Butte.

L. M. Rheem, of Helena, Montana, is visiting the Exposition.

F. W. Bradley is due here on August 4, upon his return from Honolulu.

Faris V. Bush has been elected a director of the Arizona Eastern Railway.

Guy A. R. Lewington, who now lives at Los Angeles, was in San Francisco this week.

Leroy A. Palmer has been making a reconnaissance in Mendocino and Trinity counties.

A. G. Keating has been appointed manager for the Big Jim Gold Mining Co., at Oatman, Arizona.

H. George Anderson passed through San Francisco on his way from Austin, Nevada, to Arizona.

Frank H. Pettingell, president of the Los Angeles Stock Exchange, was in San Francisco this week.

J. T. Marriner, manager for the Pahang Consolidated, has arrived in London from the Malay States.

George J. Young, professor of mining in the University of Minnesota, has concluded his visit to California.

Robert S. Lewis, of the University of Utah, has returned from a visit to the mines of Juneau and Dawson.

Philip Argall has just returned to Denver from a periodical visit of inspection to Magdalena, New Mexico.

F. W. Thompson has resigned as superintendent for the Triumph Gold Mining & Milling Co., of Lumpkin, California.

T. T. Read has resigned his position as associate editor of this paper to accept a position with the Engels Copper company, at Engels, California.

George H. Booth has resigned from the staff of the Inspiration Consolidated Copper Co. to take charge of the engineering work for the Mine La Motte Co., in Missouri.

W. E. Thorne, having been granted a temporary leave of absence by the Consolidated Gold Fields of South Africa, is now on the staff of the Lenskoie, or Lena Goldfields, in Siberia.

The following faculty has been chosen for the New Mexico School of Mines for 1915-1916: G. E. Anderson, geology; E. L. Quinn, chemistry; C. T. McKay, mathematics; and V. E. Hanson, civil engineering.

Obituary

Theodore B. Comstock, geologist and mining engineer, died at Los Angeles on July 26, at the age of 66. A native of Ohio, he graduated from Cornell University, obtaining a doctorate of science in 1886. He practised as mining engineer in Colorado and other Western States and contributed to the literature of his profession. He was a man of high attainments and character. At the time of his death he was president of the California Farm and Home Builders.

The twentieth annual meeting of the Lake Superior Mining Institute will be held on the Gogebic range on September 6, 7, 8, and 9, with headquarters at Ironwood. The first-aid demonstration will be held at Ironwood, after which excursions are planned to points of interest on the range. One day is to be spent on the Cuyuna range, also a visit to the Minnesota School of Mines and the State Fair, where the meeting will close.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, July 29.

Antimony	35 —35¾
Electrolytic copper	19½—19¾
Pig lead	6.00— 6.95
Quicksilver (per flask)	$95
Spelter	24 —24¼
Tin	39 —40½
Zinc-dust, 100-kg. zinc-lined cases	No quote

Supplies of zinc-dust are practically non-existent. Last week's price was 38c., and this week nominally 40c. per pound.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, July 29.—The copper market is dull; lead shows no improvement; spelter is quiet with a downward tendency.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
July 22	18.87	June 16	20.12
" 23	18.75	" 23	20.00
" 24	18.62	" 30	20.00
" 25 Sunday		July 7	19.75
" 26	18.50	" 14	19.50
" 27	18.50	" 21	19.04
" 28	18.50	" 28	18.62

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	....
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended July 10 totaled 5,934,615 lb., valued at $1,116,805. Russia absorbed 2,240,939; France, 1,612,389; Italy, 976,576; England, 922,763; and Denmark, 112,179 lb. Imports of all kinds amounted to 9,974,634 lb., worth $1,340,813. Chile sent, 1,872,150; Panama (passed through there), 1,381,295; Cuba, 1,120,000; and Canada, 1,310,212 pounds.

Calumet & Hecla is producing at the rate of 90,000,000 lb. per year, at a cost of about 9c. per pound.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
July 22	47.12	June 16	49.31
" 23	47.25	" 23	48.97
" 24	47.37	" 30	48.40
" 25 Sunday		July 7	48.10
" 26	47.37	" 14	47.56
" 27	47.37	" 21	47.47
" 28	47.25	" 28	47.29

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	....
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec.	49.27	....

Silver is extremely weak, and lower prices are probable.

Exports of metal from London to the East to July 7 totaled £2,753,000, compared with £3,966,000 in this period of 1914, a decrease of about 12,500,000 oz. Writing on July 8, Samuel Montagu & Co. stated that the tone has been dull and heavy, notwithstanding that the quantity offered for sale has been sometimes quite negligible. An outstanding feature of late has been the prolonged abstention from buying in this market on the part of the Indian Bazaars. It is possible that their needs have been met partly from China, but this cannot altogether account for the noticeable falling off in demand from India. The speculation in the Bazaars, which has fizzled out recently, is not likely to be the sole reason for so lifeless a condition. It is difficult to account for adverse influence at work in the Bazaars, face to face with a monsoon (wet season) of fair promise, that they should be disinclined to take advantage of the falling rates that have lately obtained. One or two contributory causes are probable. Foremost is the restriction of credit, owing chiefly to a state of war. Another likely factor is the difficulty this year in marketing cotton and other commodities, and the consequent delay the ryot (peasant) suffers before he can realize those profits he is accustomed to invest in silver. Moreover, the difficulty of arranging shipping facilities, and the high rates which rule for transport and insurance add to the embarrassment, for they effect not only the export of the industrial products of India, but also the remittance of payment in bullion thereagainst.

On May 31 the Tonopah Mining Co had about 1,202,000 oz. and the Temiskaming company 730,000 oz. stored.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June 30	95.00	July 14	95.00
July 7	95.00	" 21	95.00
		" 28	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	....
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

London is now quoting about $87 per flask.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July 22	5.50	June 16	6.66
" 23	5.50	" 23	5.82
" 24	5.50	" 30	5.55
" 25 Sunday		July 7	5.75
" 26	5.50	" 14	5.71
" 27	5.50	" 21	5.58
" 28	5.50	" 28	5.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	....
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
July 22	19.75	June 16	22.83
" 23	19.50	" 23	18.71
" 24	19.25	" 30	20 58
" 25 Sunday		July 7	22.10
" 26	18.75	" 14	22.26
" 27	18.25	" 21	20.33
" 28	18.25	" 28	18.96

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	....
Feb.	5.22	9.05	Aug.	4 45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

A curious anomaly in regard to the Australian zinc business is that in normal times zinc-sheets and shavings for cyanide plants are imported, while zinc-dust is exported. Rolling sheets is now being done locally. Recently experimenting has been done with a zinc-ribbon produced by fine streams of zinc falling on a water-cooled rotating drum, but it has not yet been determined whether this ribbon gives better results than zinc-shaving for precipitation of gold.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.80	....
Feb.	39 76	37.23	Aug.	30.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Eastern Metal Market

New York, July 23.

The metal market is in the doldrums, and it is difficult to prophesy from which direction the wind will first blow. There has been no real check to the manufacture of munitions of war, but the atmosphere is surcharged with talk of strikes at many of the big plants in as many big cities. Starting in what appeared to be an insignificant family quarrel among four labor unions as to whether millwrights should be classed as machinists, ironworkers, or carpenters, Bridgeport, Connecticut, was threatened with a wholesale walk-out at the great Remington plants located in that city, and employing thousands of hands, this on the heels of the company's announcement that it would give an 8-hr. day, with 10-hr. pay. A few hundred men struck at the Remington plant, and a few in other plants having sub-contracts, but at this writing the strike appears to be averted, just as mysteriously as it was declared. That the higher labor union officials did not favor the strike is known. There is still talk that there will be trouble at the big plant of the E. W. Bliss Co., Brooklyn, New York, which is working night and day on war orders, and at half a dozen cities in New England. Labor leaders regard the machinists' trade as one poorly organized, and in the present dearth of skilled mechanics they see their opportunity to strengthen their ranks, and place their organization on a firm basis. The general comment, even among working men, is that it is most unfortunate that disruptions should come at this time, after a long period of dullness, and just when metal workers can find plenty of employment at good wages. Where it will all end remains to be seen.

With dullness general in the metal markets all prices have declined, though it must be admitted that the quotations are largely nominal. Contrary to the situation in the metals, that of steel continues to advance, both in activity and prices. A large part of it consists of war business, either for export, or the domestic manufacture of war materials such as steel bars for shrapnel and high explosive shells. The pig-iron market, which depends more on conventional domestic manufacture, shows a little more life, but is still very dull. The trade expect a revival of demand in August or soon after that month. The demand for machine-tools such as are used in shell manufacture is sustained, and some builders have advanced their prices 30 per cent.

COPPER

The market has continued dull, with prices on the downward trend. Consumers have been so neglectful that the existing condition can be described as stagnant. In answer to the much asked question as to what is the matter with the market, two explanations are given as the primary causes: First a great deal of copper was taken a few weeks ago, then there is fear that the increased consumption may exceed requirement. The latter possibility has made buyers cautious. Again purely domestic consumption is not good, though it shows signs of betterment. The War consumption, of course, is going forward without abatement. There has been talk for weeks of war inquiries which are said to be hovering over the market, but they have not come to fruition. Quotations have declined steadily until July 21, less than 19c., cash, New York, was asked for electrolytic, although most of the producers were quoting 19.50 to 19.75c. cash. As a matter of fact, prices have been so entirely nominal that there has been no uniform level, either for first-hand or re-sale metal. High-grade Lake still commands 22 to 22.50c., with some brands quoted down to 19.25c. The exports July 1 to 23 totaled only 10,598 tons. Electrolytic was quoted by second-hands at 18.75c., cash, July 23.

ZINC

While prices have declined, the quotations for spelter are relatively stronger than those of most of the other metals. Business in prompt has been restricted by the fact that consumers are now fairly well supplied for their immediate requirements. Between July 15 and 20 the market declined about 1c. The strike troubles in New England, both actual and threatened were disquieting, but they nevertheless had less effect than most persons expected. Perhaps a greater cause of depression is the fact that the galvanized-sheet trade is dull, and buying from this direction is not heavy. The prices of this product are declining. Choice brass-mill grades are practically unobtainable at 30c., and a few odd carloads of Bertha and Horsehead have brought 40c. The exports are lighter. Foreign shipments July 1 to 23 total 2218 tons. Since the beginning of the War the exports of domestic spelter have been as follows:

August	3,079
September	17,005
October	9,160
November	11,381
December	16,309
January	13,660
February	13,394
March	8,264
April	7,894
May	6,817
Total	106,963

LEAD

The general tenor of the week has been unchanged. Deliveries of metal which was purchased in the rapid rise of a few weeks ago are now being made at a heavy rate, and many of the consumers who over-bought at that panicky time are seeking to unload even at a loss. Spot lead which is lying in the New Jersey freight-yards is being offered at substantial concessions, and is being quickly taken. The A. S. & R. Co. is still adhering to 5.75c. New York, and is reported to have done some business, though it cannot have amounted to much in view of the well-supplied condition of consumers. The re-sale metal has been sold down to 5.55c., New York. St. Louis, at 5.50c., has been extremely dull. The surplus metal must be absorbed before the market can recover its strength. The exports, July 1 to 23, totaled 1769 tons. London is reported to have done some buying, but it is believed that the purchases must have concerned Mexican lead, smelted in bond, inasmuch as London continues below New York parity.

TIN

In recent months consumers have been educated to buying far ahead, and as they are now well supplied, the market of the past few days has been inactive except for the occasional purchase of a small lot. At the same time prices are getting so low that it is felt that consumers should soon be stirred to buying. On July 23 spot Straits tin was quoted at 36.50c. Abroad a better sentiment is expected to develop with the settlement of the coal miners' strike in Wales. The London quotation July 23 was £163 10s. against £174 July 2 for spot Straits. An influence which is weakening the market is the heavy arrivals, which, up to July 23, totaled 3319 tons. On that day there was 5210 tons afloat. On one steamer which arrived July 19 was 545 tons, while earlier in the month 1000 tons arrived on one steamer from Singapore and Hongkong, and 500 tons on another boat, also from Singapore.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha, iron bbl. or bulk	10
Red Crown gasoline, iron bbl. or bulk	11		

	Per bbl
Calol fuel oil, f.o.b. Richmond Refinery	$0.85

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked* subject immediate delivery.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	*$65.00	$90.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb.	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	450.00	600.00
Tungsten ore, 65%	*450.00	540.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	subject negotiation	

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	4.75	5.63
Borax, powdered, bbl., per 100 lb.	5.25	6.10
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11 50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	" "	
Cyanide, 129%, 100-lb. case, per lb.	" "	
Cyanide, 129%, 200-lb. case, per lb.	" "	
Lead acetate, brown broken, casks, per 100 lb.	9.75	12.50
Lead acetate, white broken, casks, per 100 lb.	10.87	13.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, com'l, per 100 lb.	8.75	9.25
Litharge, C. P., silver free, per 100 lb.	13.00	15.00
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	80.00	90.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	15.00	16.00
Nitre, double ref'd., granular, bbl., per 100 lb.	15.00	16.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	15.00	16.00
Potassium bicarbonate, cryst., per 100 lb.	22.00	25.00
Potassium carbonate, calcined, per 100 lb.	30.00	40.00
Potassium permanganate, drum, per lb.	0.90	1.00
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	3.25	3.50
Soda, caustic, solid, 98%, drums, per 100 lb.	3.00	3.25
Zinc shavings, 850 fine, bbl., per 100 lb.	34.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

Final figures of production in 1914 of the following minerals are reported by the U. S. Geological Survey:

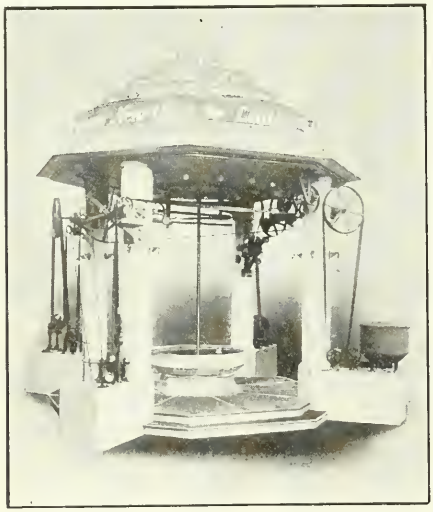
Mineral.	Tons.	Value.
Asbestos	1,247	$16,810
Barytes	51,547	153,715
Chromic-iron ore	591	8,715
Mica	4,009	606,076
Mineral paints	419,763	38,082,575
Secondary metals	....	57,039,706
Slate	....	5,706,787

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Belting at the Exposition

In the Palace of Machinery at the Panama-Pacific Exposition, the Chas. A. Schieren Co., of 30-38 Ferry street, New York, has a unique operating exhibit of leather belting running on different kinds of belt drives. The pavilion is constructed of heavy steel, so as to prevent any vibration from the running machinery. The lighting scheme gives a brilliant illumination to the belt drives illustrated. A novel fountain plays in the centre of the pavilion, it easily identifies this exhibit. It



WORKING EXHIBIT OF BELTING AT THE EXPOSITION.

directs attention to the 'Duxbak' waterproof belt running *always under water* in the basin. The manufacture of Duxbak waterproof leather is claimed to have marked an epoch in the belting industry all over the world. A steam proof belt is also manufactured. There are many other belt drives arranged on the four heavy steel columns of the booth, and also on overhead transmission attached to massive structural steel work, which is above the ceiling of the pavilion. In all there are 14 belts working, running at 30 to 5500 ft. per minute. Belts for a variety of special purposes are typified by the belt drives on pedestals extending from each of the four steel columns of the booth. There are shown characteristic drives on centrifugal machines, tube-mills, wood-working machinery, pumps, etc. All the familiar belt drives are shown, and some that are new to the general public, notably the Lenix drive. This latter enables very short drives to be arranged. The firm makes belts from ½ in. to 60 in. width, as twist leather, rawhide rope, wire-screwed solid round, oak-tanned, and patent joint leather, link-belting. Water-proof leather lacing, friction packing and hydraulic cup leathers, and belt cement is also made. Interesting catalogues have been published. During construction of the Panama Canal, 18,000 ft. of Duxbak belting was used under severe requirements.

Commercial Paragraphs

The Calumet & Hecla company has just installed 23 more large-size Hardinge Mills, 16 of these for the new re-grinding plant, six for the Ahmeek company, and one for the Lake Mining, Smelting & Refining company.

Electric-hammers, according to the Western Electric Co., New York, can be operated at from 2 to 5c. per hour, depending on the size of machine used. Wherever a rapid succession of blows makes a saving, these hammers are being successfully used.

Street-lighting brackets and centre-span fixtures for Mazda lamps are discussed and illustrated in Y-679 (44 pages) of the General Electric Co., Schenectady, New York. In many instances the fixtures would be suitable for mine plants and grounds.

The Brown Hoisting Machinery Co., Cleveland, Ohio, has published a pamphlet on the Shnable patent drag-line bucket. It is a back-dumping bucket, consisting of a shell, pulling-bail, and a combination hoisting-bail and back-gate. The bucket will dig and discharge with ease fine or coarse rock, and sticky material.

Mine ventilation is important. This is shown at 'The Mine' at the Exposition, where a No. 6 Sirocco fan, manufactured by the American Blower Co., with factories at Detroit, Michigan, and Troy, New York, is blowing air into the 'workings.' The outlet pipe is 20 in. square, and the capacity is 10,000 cu. ft. of air per minute. A Westinghouse 10-hp. direct-current motor drives the fan.

A 13-page booklet from The Lunkenheimer Co., Cincinnati, Ohio, is entitled 'Grinding.' It discusses grinding as applied to valve-seats, an important detail in all works where pipes and valves are in constant use.

In a 654-page catalogue (50th anniversary in 1912) The Lunkenheimer Co., of Cincinnati, Ohio, describes and illustrates it varied products. A lot of other valuable data is given. The output of this firm is so well known that further note is unnecessary.

Antimony has risen to abnormal prices on account of the War. In our 'Mining Summary' are frequently mentioned the re-opening of antimony deposits throughout the country. The Chapman Smelting Co., San Francisco, refiners of 'C' brand star antimony, and manufacturers of commercial antimony oxides has an exhibit in the Palace of Mines and Metallurgy at the Exposition. This includes antimony sulphide ore from various districts, metal in process of refining such as the single-first process with 95% and double-second process with 99% antimony and slabs of star metal, 99.5 per cent.

The following chemicals and products are exhibited in the Palace of Mines and Metallurgy at the Exposition by the Stauffer Chemical Co., California street, San Francisco: iron pyrite, copper sulphate (crystals and liquor), lump, crude, powdered, and sublimed, sulphur, sulphuric acid, hydrochloric acid, storage-battery electrolyte, nitric acid, sulphate of iron, block, rock, and refined salt, nitrate of soda, argol, tartaric acid, magnesite ore and calcined magnesite, carbonate of magnesia, borax (crude and products), superphosphate, Paris white, carbon bi-sulphide, metallic paint, sublimed white lead, kalsomine, and other paint powders in all colors.

EDITORIAL

T. A. RICKARD - Editor

CARRANZA dollars, or pesos, are quoted at 5 cents, and Villa dollars at 1 cent each, on Wall Street. It looks as if both the Constitutionalist and the Conventionalist causes were at a discount. Indeed, Mexico has been cursed by too many 'istas. What is needed is a Mexican party.

SILVER has been down to 46.87 cents per ounce during the past week, this being the lowest on record. In January 1903 the price was 47.57. Tonopah is worried; Cobalt is depressed; particularly as the prices of the supplies and chemicals—cyanide, zinc, and aluminum—consumed in the extraction of silver have risen considerably.

REPORTS in regard to the doubling of capacity at the Tacoma copper smelter are not quite correct. It is only the refinery that is to be doubled in capacity; but at the same time a reverberatory furnace is to be added, in order to treat flue-dust and flotation concentrate, shipments of which are now coming to Tacoma from the Britannia mine.

THE National Congress of Peru, at its current session, is to consider the question of putting an end to the free exportation of minerals and mineral products. For 18 years there has been no embargo on this export trade, but now, in view of the impoverished condition of the national treasury and the depletion of the national revenues, it is possible that such a tax will be levied.

RELIABLE news from Mexico is so scarce in these days that we are particularly pleased to publish a letter from Mexico City written by a trusted correspondent. He deals chiefly with events in the southern part of the country. He explains the financial chaos and the approach of famine. We also give a description of conditions at El Oro, as quoted from a recent report of the Esperanza Mining Company.

OUTSIDE war orders, the revival of business is slow. Moreover, the diversion of energy to the manufacture of munitions has created serious disturbance in several minor industries. Adjustment to the new conditions is retarded by the lack of knowledge as to the persistence of these conditions. Nevertheless, reports from all over the country indicate that the general outlook is unquestionably good.

AMONG the legitimate efforts to arouse interest in home mining is the Mining Bureau of Helena, which has been organized to give information concerning that part of the Montana mining region which is immediately tributary to the city of Helena. The Bureau issues lists of mining properties, with details regarding development and the price of possible purchase. The mining districts within the scope of this organization include such well-known centres as Marysville, Basin, Elkhorn, and Wickes. The Bureau itself has made a start by taking an option on the Hawkeye claim, which is within the city limits, and is engaged in systematic development of the property. We commend the example.

SOUTH AFRICAN mining is affected directly by the Union's conquest of German South-West Africa because it will open a more direct route to the Transvaal from the west coast, that is, from Europe, by the way of Luderitz Bay and Warmbad. These two points are connected by rail, and a military railway has recently been laid down from Warmbad to Prieska on the Orange river, which separates the Cape Colony and the Orange Free State. Prieska is on a branch line connecting with De Aar, which is 100 miles east and on the main line between Cape Town and Johannesburg.

SMELTER capacity for zinc ores and concentrates is being increased by about 100,000 tons of metal per annum. In 1914 the total capacity of the various plants was about 450,000 tons and the actual output 364,000 tons. By the end of the current year it will be possible to treat 550,000 to 600,000 tons, and all the plants will be running at their full capacity. The most interesting of the new smelters is that being built at Donora, near Pittsburg, for the United States Steel Corporation; it will have a capacity of 40,000 tons of spelter per annum and is intended to supply the Corporation with the amount of zinc required in its own manufacture of galvanized iron. Meanwhile electrolytic precipitation threatens increasingly to supersede the method of distillation. This would revolutionize the smelting of zinc.

INTRODUCTION of new machines is often opposed by workmen, more particularly the miner, who is a confirmed conservative. Thus the Michigan copper companies had a lot of trouble when introducing the machine-drill that can be operated by one man, as against the old two-men machine. Although the use of the one-man drill helped the contractors to make more money, it aroused the enmity of the labor-unions, partly because it put a premium on efficiency, partly because it was heavy and difficult to handle, and partly because men like to work in pairs. Efforts were made, successfully, to lighten the machines and it was arranged that they should be operated in pairs. Nevertheless the introduction of the one-man drill contributed to the Michigan

strike, for it was used as a grievance by the agitators of the Western Federation. An impartial investigation by the Commercial Club showed that the opposition to the one-man drill was unreasonable. Since the strike, moreover, the machine itself has been made still lighter and more adjustable. At the Calumet & Hecla, the drill-steel has been reduced in diameter from one-inch to three-quarters, and it is likely that the other mining companies will follow suit. Improved manufacture and better material tend to lighten the weight in all machines that more immediately supplement human labor.

MEXICAN affairs are moving to another crisis, and we believe one that promises to be fairly conclusive. President Wilson has shown sagacity in asking for the co-operation of the Central and Southern republics in restoring order in the distressful country. In addition to co-opting the ambassadors of Argentina, Brazil, and Chile, he has invited the ministers of Bolivia, Uruguay, and Guatemala to a conference. Before these lines appear further information will have been published. Meanwhile it is announced that it is proposed to give the factions in Mexico a limited period wherein to end hostilities and to arrange for the orderly restoration of constitutional government. If they fail, it is likely that General Carranza may be recognized as Provisional President and an embargo placed on the exportation of munitions of war to other factions. General Carranza, it is reported, has agreed to hold an election and not to offer himself as a candidate for President. Apparently he has abated his truculence and is in a more reasonable frame of mind. This is most important, for the leader of the Constitutionalist party has neither the temper nor the personality required for the heavy task devolving on any man that is to bring harmony out of the discordant elements of Mexican misrule. By the same token all the present factional representatives will have to be eliminated, in order to minimize internal jealousies and give the new regime the chance of general support.

NICKEL is a metal for which intensified demand has been made by the War. According to information from Berlin, the price of nickel anodes in June was $55 per hundred pounds, while sheet nickel was quoted at $60 per hundred pounds. At that time the New York price was $50. The comparison suggests no scarcity in Germany. As the chief source of supply is Sudbury in Ontario, Canada, the British government has taken pains to see that none reaches Germany. From Canada it is shipped as a matte to New Jersey to be refined. In order to exercise greater control over the industry, the government of Ontario has appointed a commission to enquire into the feasibility of refining the nickel matte in Canada. This commission is headed by Mr. George T. Holloway, a British metallurgist of high repute, together with Messrs. Willet G. Miller, the Provincial Geologist, McGregor Young, an authority on international law, and Thomas W. Gibson, Deputy Minister of Mines. It is fortunate that the Imperial government insisted on the appointment of an experienced metallurgist as chairman of the commission, for it is manifest that the other members, honorable and accomplished as they are, possess no obvious qualification to decide upon the question of refining nickel matte in Canada or elsewhere. The commission looks like a sop to public sentiment, for it is extremely unlikely that its report will be applicable to any emergency created by the War.

Wild-Cats

A recent dispatch records the killing of a wild-cat in the streets of Portland. The head-line in the local newspaper suggests that the stranger had inadvertently wandered into the city from a neighboring mining district, but the details show that he had been raiding the hen-roosts, not the pockets, of respectable citizens. Time was when the word wild-cat connoted predatory schemes for selling worthless mining claims to simple people. It used to be said that Western Australia was free from rabbits because the exponents of feline finance drove back the prevailing Australian pest in its effort to encroach into the precincts of Kalgoorlie and Coolgardie. Not long ago the editor of a London periodical was threatened with a libel-suit because he described the Bullfinch mine as originally a 'wild-cat.' He explained that the term, as used in Western America, had become almost one of financial endearment and no longer conveyed any idea of villainy. The lawyer representing the Bullfinch company declined to accept the explanation, because, of course, he was not up-to-date in the use of mining terms.

To be serious, it is remarkable how the word has lost its sinister meaning. At first used to indicate schemes of deception based on worthless locations, it became employed to signify a risky venture or a forlorn hope. An enterprising and yet thoroughly respectable mine-operator would say that he was "wild-catting" in Arizona or Nevada, meaning thereby that he had bought or optioned a number of claims having only what a Cornishman calls "symptoms of indications," but usually in the vicinity of some discovery of proved value or in a new district just coming to the front. Thus the wild-cat became almost as respectable as a 'prospect,' differing from it mainly in the lack of an outcrop or other visible sign of ore. In a way, this gain of respectability was the result of the proof that orebodies valuable for the precious metals might lie under a flow of andesite or that a mass of disseminated chalcocite might be covered by a considerable thickness of worthless gossan. In short, the wild-cat became the type of venturesome mining enterprise of a quite legitimate character. Indeed, so long as the owner of a wild-cat is willing to retain possesion of his untamed property and does not use it as a lure for enticing less experienced people into flimsy share dealings, we must recognize that this phase of mining adventure plays a useful part. Without risk there would be no mining. Unless the possibilities of mineral distribution are tested by courageous explorers, we shall soon see an end to a great industry. It is the recognition of the wild-cat stage of mining as a possible

incubator of productive enterprise that causes the general public to use the term without the suggestion of either ridicule or disapproval. We should be careful not to shoot at wild-cats, even when they come near the city boundaries, until we are sure that the agile vagrant is not a respectable domestic pet made fierce by unkindly treatment. The word has come to signify a recognized feature of Western exploration; when we want to designate a mining claim that is being used for predatory purposes, let us call it a 'swindle' or a 'fraud.'

Trade With South America

Expansive ideas of creating trade with Central and South America have been chilled by a closer acquaintance with the real facts. If amiable sentiments could establish new avenues of commerce, the thing would be done already. Of good feeling on both sides there is plenty. The Spanish-speaking peoples of what is euphemistically called Latin America have suffered enormously from the War. Accustomed to do business on credits established with London or Hamburg, they find that this medium of exchange is not available to them as heretofore. They turn to their big neighbor in the North, who, like them, has found much of his customary trade shattered by shrapnel, and the fellow sufferers are now comparing notes with a view to arranging for dealings direct with each other. It sounds simple, but a new international credit system, with its elaborate scheme of acceptances and discounts, cannot be created in a day. Its predecessor was the work of years and the outcome of a confidence that had been thoroughly tested. A similar correlation of trade and finance between the United States and the southern Americas cannot be established without considerable preparation; not sowing only, but spade-work is needed. Many of our existing laws regulating banking and shipping will have to be modified for the purpose. Our banking arrangements are as yet in their elementary stage of development as regards foreign business. To talk glibly about American banks establishing branches or agencies in South America is pleasant enough at a Pan-American congress, and the National City Bank of New York, which has begun an energetic and intelligent propaganda for South American trade, has set an example by establishing three branches; but the fact remains that the 27,000 banks in this country could hardly muster 50 bank-officials properly prepared to undertake to do the work that is required in Chile or Peru, in Bolivia or Argentine. The knowledge of Spanish, as of other languages, has been largely ignored by a commercial community grown accustomed to expecting its clients and customers to speak to it in its own language. Our people are not linguists because their business is mostly with people that either speak English or take the pains to learn the official language of the United States. Moreover, most of the men likely to be chosen for a financial mission south of the equator are little habituated to foreign ways and are so set in the idea that their own ways are the best that they make poor diplomats. "Do unto others as they would do unto you, but do it first" is a simple code, but "put yourself in the other fellow's place" is, on the whole, the better motto for establishing friendly relations with strangers. To succeed in transacting real business—that is, business mutually profitable—it is necessary to forget that they are strangers.

But let us suppose that these fundamental obstacles are removed. Others remain. Individual banking houses are not likely to start a campaign in South America while the banking system of this country is still under trial. The Federal Reserve Board has begun to inspire confidence, but it is fair to say that five years more must pass before it can be said to have made good definitively. Until some such interval has elapsed not many conservative houses are going to assume the risk of a new departure abroad. Therefore the only practicable plan is to form an association of banking interests for the particular work of facilitating exchange with South America. In furnishing capital for this enterprise the various banks could participate, leaving the actual management to a board composed of financiers having special knowledge of South American conditions. The bank so constituted would then furnish the credits required for the opening of new avenues of trade. The South American is accustomed to long credits, not cash discounts; he considers that by employing personally his money during the time the bill is maturing he can make a larger profit than the discount to be received for a cash payment. Long credits, such as he has been getting at London and Hamburg, are a habit of his, and if the North American desires to trade with him, this fact must not be brushed aside as a negligible peculiarity. In any event, banking arrangements alone will not suffice. North American capital must be invested in South America and more steamships must ply between our ports and theirs, if the new commerce is to be put upon an enduring basis. And when we have prepared to meet all these requirements, we shall be haunted by the thought that as soon as the War in Europe is over our friends in the South will probably fall into their old ways of drawing bills on London or Hamburg, and preferring trade with England or Germany.

Meanwhile we may welcome such visitors as Dr. Alfonso Quinoñez, the vice-president of San Salvador, who sets all of us a good example by coming to California with the purpose of learning our language, so that he may prepare himself to aid the establishment of better commercial and political relations. San Salvador is a little country, but it is populous and rich, and it is the best governed of all the Southern republics. It lies comparatively near us and is desirous of decreasing the distance by goodwill. While New York and Boston must undertake the main task, there is no reason why San Francisco should not do her share by establishing communication, by ships and by credits, with the nearer countries on the Pacific coast. One of the means to the same useful end would be the erection of a smelter for the treatment of Bolivian tin ores. At present this tin product—usually in the form of a concentrate—is shipped to Amsterdam or Liverpool, to be used in the manu-

facture of tin-plate, some of which is then shipped across the Atlantic and thence over the continent to California for the making of the tin-cans in which our oil, fish, and fruit are exported. By smelting this tin concentrate in California and making our own tinplate, we could obviate a large number of intermediary operations. Moreover, the smelting of the ore would stimulate interest in the mines from which it was derived and would thereby promote transactions between our mining people and those of Bolivia. It would be a logical method of establishing trade. Let us hope that out of the present rapprochement between the two Americas there may arise such relations as will illustrate the realities of political economy.

Potash

Interest in potash salts has been keen in this country for several years, as consumers feel that the virtual monopoly of the output in Germany, where the trade is closely organized and production restricted, places them in an unpleasant industrial situation. This interest was accentuated last year by the outbreak of war and a further restriction of exports by the German government, followed in January last by the declaring of an embargo. Imports during the third and fourth quarters of 1914 were about one-third of normal. Imports in February of this year, as given by Mr. W. C. Phalen in the 'Mineral Resources of the United States,' show that normal amounts of carbonate of potash, caustic potash, and 'other potash salts' were received during the month. Chloride of potash imports were double the normal figures, cyanide of potash showed an enormous increase, 266,654 lb. having been received, while imports of fertilizer salts were only about one-tenth of normal. Since February 1, only one cargo of German potash salts has been received, according to the Department of Commerce. Trade conditions have been correspondingly disrupted, and it will be worth while to review briefly the various lines of progress being followed in attempting to create an independent source of supply in the United States.

The potash deposits at Searles lake, in California, are well known, and the progress made in their exploitation by the American Trona Corporation was editorially reviewed in our issue of May 23, 1914. It is only necessary to add that the process that it was proposed to use at that time proved not to be economically feasible on a working scale, and regular production has been delayed until the necessary modifications can be made. It is reported that the Corporation now hopes to be able to begin to supply the market within a few months. The search for other lake-bed deposits has been carried on both by the U. S. Geological Survey and private corporations throughout the arid regions of the United States, especially in Nevada, but without success as yet. The discovery of potassium nitrate deposits has been reported from Texas and Oregon, but they have not been sufficiently explored to indicate whether they can be worked profitably.

The alunite deposits of Utah are apparently of great promise, and a plant is under construction at Marysvale; it is reported that one of the large fertilizer companies of Chicago is the financial backer of this enterprise. The chief difficulty is that there is practically no market for fertilizer salts in the Rocky Mountain states, and the high freight-rates to the eastern and western seaboards, as compared with ocean freight-rates, places these deposits at a disadvantage.

Much has been written about the kelp groves of the Pacific coast, and much was at one time expected of them. Unfortunately kelp, when first cut, consists largely of water, and the cost of handling and removing this water is excessive. By allowing the kelp to dry in the air and then comminuting it, a product is made that is suitable for fertilizer, but there seems little hope that pure potash salts can be made from it, as the kelp tissue has absorbed the salts from sea-water and cannot easily be made to give them up again. A recent British patent proposes the use of a temperature and pressure high enough to produce the desired result. As it has been estimated that 2,300,000 tons annually of potassium chloride could be derived from kelp on the Pacific coast, experimental study will be continued, and it is quite possible that some satisfactory method will in time be devised.

Feldspar, which occurs widely distributed and in abundance, contains considerable amounts of potash. Messrs. A. S. Cushman and G. W. Coggeshall have devised a method for recovering it that consists roughly of burning the ground feldspar together with chloride of lime in a kiln, as is done with cement clinker, thus converting the potash into the chloride form. The clinker is then leached, and a product containing 75 to 85% potassium chloride is made by evaporation. There has been some delay in getting this process into operation, but the inventors are still hopeful of success. Mr. A. K. Cowles has patented a process in which ground feldspar is subjected to the action of the vapor of water and salt in a rotary furnace. This is intended for the production of sodium salts, however. The Hart process, for which an experimental plant is to be built at Easton, Pennsylvania, depends upon the fusion of feldspar with potassium or sodium sulphate. This produces a glass that can be decomposed, after crushing, with sulphuric acid, yielding pure silica and a solution of the sulphates of potash, soda, and alumina. It is obvious that the chief problem in this process is the operating cost.

Another source of foreign potash has been discovered in Spain, where large deposits have been proved to exist near Barcelona. These have not been developed beyond the exploration stage as yet, and the Spanish government is still considering the amount of control that should be exerted over the development. Strong financial interests are engaged in developing these deposits and the possibility that within a few years the German monopoly may be broken by the creation of a source of independent supply in Spain makes them of much interest to the American consumers.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Cost and Efficiency

The Editor:-

Sir—I have been much interested in the reading of an article in your journal by Mr. Heath Steele on the subject of 'Cost and Efficiency' together with your editorial review.

Your statement as to the "economic success being measured not in the cost per ton, but the profit per ton" is of course unanswerable. Mr. Steele's desire "to change the almost universal method of recording costs only in dollars and cents," while having much to recommend it from a statistical point of view, seems to me to be in conflict with your dictum in that it would attach undue importance to an immaterial part of mining operations. The amount of energy and material represented by the cost data expressed in money is comparatively of little importance except for internal check work. Apart from this I do not consider that costs are intended to furnish data for estimates. That many of the mining-cost figures published are abstruse is true, but this might be the result of managers paying more attention to the economic side of mining than to the compilation of pretty statistics, justified in some cases by the extent of the operations not being large enough to provide the necessary organization, but more often I fancy by the almost hopeless task of finding any two mines even in the same district working under exactly similar conditions.

If the working conditions are at all similar, and if sufficient analysis of the cost-sheet is made in each instance, I do not see any advantage in ascertaining, except for purely internal check, that the number of tons of ore handled per man is so much, or so little, over the statement that the same dealing in the ore costs so many cents per ton more or less. Quite the contrary. Having ascertained that some portion of my neighbor's costs were lower than mine, I should set out to ascertain the reason. In the supposititious case of two mines in the same district using identical systems of mining and milling, an ordinary detailed cost-sheet would show in what way the extra money was being expended. In any case, if one mine sorted its ore and the other did not, their systems of extracting ore could not be called identical. If it were possible to conceive two mines in a district working the same class of ore, mining and treating equal quantities, and with exactly similar mining and milling systems, any variation of cost, operation for operation, would be *prima facie* evidence of bad work on the part of one of them, and I maintain that it would be easier to consider the difference in cents per ton of ore handled than the fact that one mine used the decimal part of a pound of some material less or more than the other, or that the tons per man handled were greater in the one case than the other. One would assume, in two mines working under similar conditions, that the labor rates were the same and that their power of purchasing supplies were equal. Personally, I cannot conceive of any two mines working under exactly similar conditions, which constitutes my chief disagreement with Mr. Steele's article, and so comparison with the "other fellow" is not of much use and, for the guidance of the managements, dollars and cents per ton of ore handled are more convincing than other factors, provided that the dissection of the total is made with sufficient intelligence.

If one were to consider the "other fellow's" costs, one would naturally look at it in the terms of money first of all, and endeavor to ascertain the reason. In doing so, no one factor by itself would be of use, for example, the number of tons secured per man could only be considered in relation to the relative cost of wages. Twenty men in one district might do the work of 40 in another, and yet the cost per ton might be the same. In the former case each man would need to secure double the quantity of ore of the latter, and it would not follow that the organization and superintendence of the latter would be at fault; the management would be doing the best it could under the circumstances as they existed, as is sufficiently proved by the fact of the cost per ton being the same and the maintaining of the ratio between cost and profit.

As regards making an estimate of the cost of operating a new enterprise, the geology of the district and the nature of the country, width of lode, etc., would not be known unless some other mine was working on the same line of country. In this case one would consider the extractable value of the ore and the cost of handling to ascertain the profit to be derived. The analyzed cost-statement of the mine at work would be a safer guide than the knowledge of the amount of tons of ore handled per man under conditions probably quite different.

If an eminent mining engineer from South Africa fully primed with all the facts suggested in the article, based on his experience with colored labor, etc., were to attempt to manage an Australian mine purely on the result of his experience, applied in a hard and fast manner, one might reasonably expect disaster. Similarly, if an American used to high-grade labor were to endeavor to obtain the same results per man with in-

different colored labor, he would be worth much more than his weight in gold—if he were successful.

There is no gainsaying the fact recorded by Mr. Steele that the dollar is not a definite expression when used to denote quantities of labor and material, but it is these quantities when expressed in dollars that you have to regard, if it be true that the economic success of a mine is measured by the profit per ton and not by the cost per ton.

I fully recognize the necessity for many of the statistical data, though I am not capable of understanding the utility of recording, for example, the "drills sharpened per foot drilled by machines." The majority of the suggestions are good and the facts are, I believe, ascertainable as regards most of the large mines on this goldfield. But in recognizing the advantage of records of efficiency I cannot but think that it is putting the cart in front of the horse or confusing cause and effect to suggest that these records are of equal or greater value than the costs expressed in terms of money. Ascertain first the cost in money and then, if it is possible to compare with some other mine working under similar conditions, trace back the reason of the variation, having regard always to the various factors to be considered.

You state in your editorial comment that the unit of measure must be one applicable under varying conditions and that the dollar does not suffice in mining for purposes of comparison, but it is the dollar and not the energy and material consumed in the operation that has the effect on the profit per ton. Moreover the dollar remains constant for comparison but the energy consumed must vary with conditions. To quote further: "It is the average tonnage of ore broken per day per man that gives the relative efficiency of the labor employed." True; but it is the cost per ton of ore broken that is of more importance, particularly if you agree with what I maintain, namely, that comparisons as between mine and mine are not valuable, or rather that the essential value of comparison is of different periods on the one mine.

A. E. JACOBS.

Kalgoorlie, June 21.

Flotation at the Inspiration Mine

The Editor:

Sir—In reading an article in a recent issue of the PRESS in which the different flotation machines used at the Inspiration test-mill are described, I notice an account of one which is said to be of the Hebbard type, with agitation gear of the standard Minerals Separation pattern. As I have seen the machine at the Inspiration and read the specifications of Hebbard's U. S. patent No. 1,064,209, I wish to point out that the machine mentioned resembles Hebbard's only in not having any under-pipes connecting the spitzkasten to the mixing-boxes, chiefly because there are no spitskasten, whereas Hebbard's patent is for a machine with staggered spitzkasten, that is, each spitz is *not* exactly opposite each mixing box, as in the standard M. S. machine. In fact, his apparatus resembles T. J. Hoover's valveless apparatus, described and illustrated on pp. 144-5 of Hoover's book on flotation, and covered, I presume, by one of his patents. I understand that a machine of this Hebbard-Hoover type is, or was, used by the Zinc Corporation at Broken Hill in connection with the Horwood process and works satisfactorily on slime, but I am afraid that sand would collect in the spitzkasten. The machine at the Inspiration, on the other hand, handles sand and slime without any trouble.

W. MOTHERWELL.

San Francisco, July 29.

Concentration: Then and Now

The Editor:

Sir—I will tell you an interesting fact about concentration; we don't do as good work as was done 25 to 30 years ago. Of course, there was some dirty work then too, but on an average the mills saved from 85 to 90% of the assay-value, while now some mills on the same ore don't save 60%, about 70% being the average. I have followed the business for close onto 30 years, so I ought to know something about it. Take the two Nacozari mills; the old mill saved from 70 to 80%, the new mill from 50 to 60%, and the new mill is supposed to have all the latest improvements. When jigs were replaced by tables, the mine-owners were willing to stand a loss of from 10 to 20% to get a fool-proof machine in their mills. Anybody can tend tables and almost anyone can tend jigs, but good jig-men who know their business are scarce; at least I find it so. I would like to see one of your modern mill-men or builders handling all that table-feed on high-speed, 400 lb. per minute, and save 90% of the assay. To show you the difference in your mill-bosses, the Nacozari mill had the sieve-frame made out of wood in squares, but the cross-slats were cut in two, so that every time the plunger went down, the whole pulp came up because the sieves were far too deep. If there had been stiff sieve-frames the eccentrics would have been heated red-hot. What was the consequence? The ore worked over the jigs into the Chilean mills to be slimed up and floated out. Now take a mill in California; there the mill superintendent put in cast-iron frames and bolted the sieves on with bolts. Now, how did that work? Why the eccentrics got red-hot, so it took an extra with a hose to cool them off, and also fill the grease-cups as much as three times on an 8-hour shift. Why? Because the superintendent and foreman did not understand their business.

My contention is that all the feed that is put on tables can be better handled on jigs and make cleaner concentrate and lower tailing. But it takes first-class jig-men to do that; in fact, tailing ought to be so low that it would not pay to treat it by flotation. The speed, stroke, depth of sieve, size of mesh, size of wire, and bedding must fit the particular feed to do good work. There are mills in the Coeur d'Alene where the foreman ordered punched screens for sieves because a punched screen is cheaper; that is like saving the nickels and throwing

the dollars away. A punched screen has not enough holes at the start, and after it is in use, say, for half a day, it is blind, to stay blind.

The next time you visit a concentration plant, take a peep at the trommels and see how nice the pulp sticks together, no sizing, but wearing out the screen because the trommel is not finished right.

If you can use any of this, use it, but I don't think you will because you might lose some money in your ad. columns.

JOHN EBENSTEIN.

Salt Lake City, July 23.

Efficiency Engineering in Mines

The Editor:

Sir—The International Engineering Congress, which meets in San Francisco, September 20-25, announced a paper on the 'Organization and Staff of Mining Companies.' For business reasons, the engineer who was to write this paper has found himself unable to complete it, and the undersigned have been asked to edit a symposium on the subject. One of the many points on which we should like information is in regard to the application of the Taylor system of scientific management to mining work. It was therefore with great pleasure that we read the very interesting article by P. B. McDonald in the MINING AND SCIENTIFIC PRESS of July 24.

We have not fully investigated the references, but apparently very little has been written on the scientific management in mines and a number of the articles that have appeared are in papers devoted to coal mining and are not to be found in the public libraries near San Francisco, or, at least, we have not yet found them. And in the latest book,—'Scientific Management: a collection of the more significant articles describing the Taylor system of management: Clarence B. Thompson, Harvard University Press, 1914'—there seems to be no reference whatever to mining.

We are very desirous of having more information on this interesting subject and invite Mr. McDonald and all other engineers to send us data or articles that we can use in the symposium referred to above. Discussions of the attitude of miners toward scientific management will be valuable. Mr. McDonald writes of "the sullen opposition of a great mass of miners." Was not this due to the fact that the introduction of the scientific management was too much hurried? Taylor himself points out the absolute necessity of proceeding with great caution and slowness and states that the introduction of the system should be so arranged that a "complete mental revolution" should take place, and "that without this complete mental revolution, scientific management could not exist.

"This mental change is great and far-reaching. It means essentially a change from suspicious watchfulness and antagonism and frequently open enmity between the two sides, to that of friendship, hearty good-will, and cooperation. It means a change from the old belief that the interests of employer and employee are in many respects necessarily antagonistic, to the firm conviction that the true interests of the two are mutual."

Another point: What percentage of the saving due to scientific management was paid to the miners? In the classic case of Schmidt, his daily task was raised from 12.5 tons of pig iron handled to 47.5 tons; his wage was raised from $1.15 to $1.85. In this case the total saving made was about $2.50, of which Schmidt received $0.70, or 28%. Similar statements with regard to mining work will be most acceptable.

What is the present attitude of the management and the miners—both in the Lake Superior region and elsewhere—as regards scientific management?

We hope that some reader of this letter will take enough interest to send us the information that we ask for; it ought to be of interest to all who are connected with the mining industry.

Letters should be addressed: International Engineering Congress, Foxcroft building, San Francisco.

R. E. CRANSTON,
W. H. SHOCKLEY.

San Francisco, July 26.

[We take pleasure in publishing this letter, hoping it may elicit the information and assistance desired.—EDITOR.]

COPPER SHARES are now selling on a 20% dividend basis. This indicates that the public is convinced that the present price of the metal depends on the continuance of the War. Those who are trying to forecast the future seek to determine the effect that the decline in our copper exports, taken in combination with a rapidly increasing output, is likely to have on the price. Reduced to pounds the exports from New York were January-June 1914, 491,666,560; January-June 1915, 304,017,280. Decline 187,649,200. This drop of 38% is easily explained by the absence of Germany as a customer. But the question is: Can the copper market stand this loss in export and an increased production on a scale vastly greater than ever before witnessed? New mines are beginning to put a large product on the market and the old timers are speeding up operations to maximum capacity in order to take advantage of 20-cent copper before the tide goes out. Before the end of this year the American production of refined copper should be brought up very close to an annual basis of 1,500,000,000 pounds, a total 20% larger than the previous high point of 1,253,000,000 pounds in 1912. In addition to this home business is depressed; one of the largest brass manufacturers in this country reports that outside of the war demand the copper and brass business in this country today is not better than 60% of normal. From the speculative point of view there has been no overbooming of copper shares and in fact on several previous occasions they have sold at their present price level on a 15-cent metal market.

COPPER PRODUCTION of Peru in 1914 (bars, matte, and ores) totaled 25,070 long tons, a decrease of 2258 tons.

Buying Mining Supplies

By P. B. McDONALD

An iron-mining company in Michigan that operates half-a-dozen big mines wished to get a new type-writer. The district agent called and offered to take back the old machine at a certain price as part payment on a new one. The superintendent thought he should get $2 more for the old type-writer. There ensued much haggling. The cashier entered the discussion. After a time the manager of mines came in and took sides against the agent. They argued most of the afternoon. Finally, the agent, though still protesting that the old machine was not worth it, offered to pay the $2 out of his own pocket. The mining company would not agree to that, but the price was compromised by each side giving up a dollar. The mine officials knew that to save $1 they had used up time worth many dollars. It wasn't the $1 they were after; what they wanted was the reputation of being close buyers. They figured that a name among mining-salesmen for being hard traders was a valuable asset. Under certain conditions it is; sometimes a little saved at the spigot makes a critical difference. Such, however, is the peculiar nature of mining and the men engaged in it that it is not usually wise to run mines like a shirt-factory in a sweat-shop district. The "penny-wise, pound-foolish" spirit is apt to permeate all ranks and react in ways the management has not foreseen.

As a rule supplies bought with some sense of proportion are well worth the prices asked. There is a good deal more waste around a mine from buying things not adapted to the work than from over-charging by mine-supply houses. A superintendent devoting time to studying out what type of supplies are necessary or unnecessary will probably save more money than by haggling with salesmen. An exceptionally big order or a first order of machinery in a new district will usually succeed in securing low prices. A mining-machinery house likes to get its name-plate on installations in a new district for an example to future buyers, as mining companies frequently "follow the leader" in selecting types of machines. A certain mine-superintendent averred that mining-machinery costs $\frac{1}{3}$ to manufacture, $\frac{1}{3}$ to sell, and brings $\frac{1}{3}$ profit, until one day a salesman retorted sarcastically that the estimate was correct except he had figured the profit too low. It is not generally believed that mining-machinery houses make undue profits. Their business is erratic, they have to take chances on new types and improvements, most of them use exceptionally good material and take extraordinary pains in tempering or treating it. Some of them consistently lose money by supposing that they know all about conditions underground, and by assuming that they understand all about miners and mining men, their wants and requirements, much as it is reported American manufacturers attempt to dictate to South Americans what tools they ought to want. A large copper mining company in the Lake Superior district is surprisingly lavish in furnishing repair-parts or new tools to its employees. It figures that labor costs so much that only the best tools should be used in order to obtain a maximum efficiency. The employees, being an intelligent class of laborers, see the point and give good service. A certain mine in the South has to depend on resident labor of a shiftless sort; in self-defense it is forced to be niggardly in every respect in order to be understood by the employees. Otherwise the force of "poor white trash" and niggers would waste time, tools, and ore, in thinking the management was careless.

Only the largest mines can afford a purchasing-agent. At most properties the superintendent or manager does the buying, assisted by the bookkeeper or supply-clerk. Even when one company operates a number of mines, it often prefers to let each individual superintendent suit himself in his buying, except perhaps on contracts for comparatively staple articles, like dynamite or oils. Sometimes superintendents have to accommodate their buying to periods when the company can afford it, so they buy "by fits and starts."

It pays to have a live man to tend a warehouse, and look after giving out supplies to the miners and mechanics. Sometimes the time-keeper or mine-clerk does this. He can be of great service to the superintendent in ordering new supplies; the men make criticisms to him about tools, valves, packing, oil, etc., that they wouldn't make to the superintendent; if they did, the busy superintendent might be thinking of something else and so forget the remark immediately. A car of rails came to a mine in Minnesota, was unloaded, and the car taken away. The bill came along, deducting the weight of the car from the gross weight. The weight of the car on the bill was a whole lot less than the market weight on the side of the car, as the supply-clerk could prove by the car-number. The amount saved was appreciable.

There is a tremendous variety of articles needed at an active mine, particularly where a mine is increasing its activities. At a Minnesota underground iron-ore mine, where there are numerous pumps and engines, it is necessary to keep on hand a different kind of steam or water-packing for every piston-rod and valve, and there are dozens of them. Bushings, gaskets, gauges, valve-seats, pipe-fittings, boiler-compound, oils and greases, waste, pipe-covering, machines and machine-parts, rock-drills, pumps, explosives, illuminants, timber, lumber, tools, iron and steel, nails and spikes, lantern-globes, rails, cars, rope, wire, pipe; there's no end to what a mine needs.

FINAL FIGURES of the production of explosives in the United States in 1914 are to hand from the U. S. Bureau of Mines. They were as follows: black powder, 206,099,700 lb; high explosives other than permissible explosives, 218,453,971 lb.; and permissible explosives, 25,697,818 lb. The total weight was 450,251,489 lb., or 225,126 short tons. In 1914 the output was 250,008 tons.

GOLD OUTPUT of the St. John del Rey mine, Brazil, in the year ended February 28, 1915, was $2,200,000 from 199,234 tons of ore.

Leaching Copper Ore

By W. LAWRENCE AUSTIN

In leaching natural or artificially oxidized ore the most common practice has been to dissolve the copper by means of free acid, and then remove the metal from solution by precipitation on metallic iron. This method commends itself by its simplicity, but has the serious disadvantage that both lixiviant (acid) and precipitant (iron) enter into combinations which render them unavailable for further use in the process, unless its simplicity is destroyed. Furthermore, copper deposited from solution in the conventional appliances employed for the purpose is contaminated with other substances, and must be purified through additional metallurgical operations.

The cost of acid and iron therefore becomes of paramount importance in considering the treatment of copper ore by this process, because of the losses entailed. Where sulphuric acid has been used as a lixiviant, experience has shown that acid consumption ranges between two and nine pounds of acid per pound of copper brought into solution. This does not include attempts to leach cupriferous ore where the gangue was composed largely of lime, in which case the consumption of acid was, of course, very large—indeed, prohibitive.

Sulphuric acid (the solvent usually employed in leaching copper, but not necessarily the best in all cases) can be produced under favorable circumstances for $5, or less per ton. The price depends upon the strength of the acid. Commercial acid varies from 50° to 66° B. The latter is supposed to be straight acid (100% H_2SO_4), but often contains considerably less—as low as 93%. It requires 1¼ times as much 60° B. acid to do the same work as a like weight of 66° B. acid, and 1½ times the quantity of 53° B.

Whereas sulphuric acid can be made cheaply at industrial centres, when delivered at outlying mining camps the cost is much increased. Probably 1 to 1½ cents per pound would represent the average cost at the mine, omitting exceptional cases. As three pounds of acid per pound of copper dissolved can be assumed without serious error as representing the average acid consumption with ore reasonably free from other soluble ingredients, the cost of the acid item will, therefore, range from 3 to 4½ cents per pound of copper recovered, when the acid is wholly consumed.

Iron for precipitating purposes may possibly be purchased in large quantities for $10 or $12 per ton at Pacific Coast ports; but delivered at the mines in comparatively small quantities it will cost from 1c. to 1½c. per pound. As it requires seldom less than two pounds, and more frequently three pounds, of iron to precipitate a pound of copper from acid solutions in apparatus where the liquors are exposed to the oxidizing influences of the air, the cost of iron precipitation will vary from 2 to 4½ cents per pound of copper recovered in the form of precipitate.

The precipitate obtained by passing copper solutions over metallic iron may contain as high as 80% of copper; but usually it is mixed with other substances so that 60% copper might be considered a fair average. It often assays much less. Freight, treatment charges, etc., on this precipitate will not average less than 3c. per pound of contained copper, and may reach 4 cents.

From what has been stated in the foregoing, it is apparent that the cost of producing copper by the acid-iron method will range from 8 to 12 cents per pound of copper for the acid, iron, refining, and marketing alone, without considering mining, crushing, mechanical handling, pumping, interest on investment, amortization, and general expenses. It is evident therefore that to yield a profit at the average price of the metal some other method than the apparently simple one outlined above must be devised for leaching ore in small outlying deposits of copper.

As far as the solvent is concerned, in the majority of instances sulphuric acid will be found the most available, although in special cases resort may be made advantageously to other lixiviants—for instance, where recovery of substantial quantities of the precious metals is desirable.

But it is not necessary to consume all the acid, as is done when iron is used to remove copper from solution: it may be in large part conserved and returned to the leaching-vat, thereby reducing the acid cost very materially. This can be accomplished by employing a precipitant that liberates the acid radical from the dissolved copper without forcing it into combination with another base.

Deposition of copper from solution by means of the electric current (electrolysis) fulfills the conditions enumerated; but an electrolytic plant is expensive, and experience is necessary for its proper manipulation; besides, it has defects of its own. In starting a small leaching operation it is best to avoid burdening it with such a delicate factor as an electrolytic department, however attractive the method may appear from a theoretical standpoint.

Among chemical precipitants there is one that completely removes copper from any solution obtained in ore-leaching, no matter how little of the metal it contains. It is cheaply produced and has been repeatedly used for the purpose indicated. This reagent is hydrogen sulphide (sulphuretted hydrogen), and there is much to recommend its use as a commercial precipitant of copper from ore-lixivium.

Hydrogen sulphide acts on a copper solution as indicated in the formula: $CuSO_4 + H_2S = CuS + H_2SO_4$. In other words, when the gas (H_2S) is brought into contact with a copper sulphate solution (lixivium) at ordinary temperature and atmospheric pressure, copper sulphide (CuS) is thrown down as a black precipitate, and sulphuric acid (H_2SO_4) is liberated. The reaction is complete—all the copper is quickly removed as a solid and settles out of the liquor. After allowing the copper sulphide to separate, the clear solution containing free acid is ready to be returned to the leaching-vat to dissolve more copper.

Among the advantages of employing hydrogen sulphide as a commercial precipitant for copper are:

1. The use of weak lixiviants is permissible, and a rich lixivium is not necessary as in electrolysis. Hydrogen sulphide will precipitate copper from a solution carrying one-tenth of one per cent (0.1%) of the metal just as well as it will from a 5% solution. The advantages of this feature are manifest. In employing weak acid lixiviants (1% acid by weight) a selective action of the acid for the copper is exercised, and other elements are only slightly attacked. Consequently less acid is consumed. A 10% acid lixiviant dissolves the oxidized bases indiscriminately, thereby causing heavy acid consumption and increasing acid cost. Concrete vats and launders may be used with weak acid lixiviants.

2. Hydrogen sulphide introduces no foreign salts into the leaching liquors. When the blue, or green, color of the lixivium has disappeared the operation is complete: all the copper has been removed, and, after settling, the solution can be returned to the leaching department.

3. Hydrogen sulphide for metallurgical purposes can be made in a number of ways. The usual method is to treat iron monosulphide (FeS), or matte, with sulphuric acid; but there are cleaner, as well as cheaper, means, familiar to chemists, by which the gas may be obtained in large quantities.

The gas has poisonous qualities, and for this reason objection has been made to its use. The same fault can be found with fuel-gas, also illuminating gas. Hydrogen sulphide, like carbon monoxide, can be handled with safety when proper precautions are taken: the one need be no more dangerous than the other.

Hydrogen sulphide gas has been employed in several places for precipitating copper from mine-water. It is a matter of record that the gas was successfully applied for the purpose specified after precipitation by means of metallic iron had proved unremunerative.

4. Hydrogen sulphide is an inexpensive reagent, and the apparatus required for generating the gas is simple. As there are various methods of manufacturing hydrogen sulphide, the apparatus must necessarily conform to the material available in the locality where it is to be employed, and will therefore differ in construction and cost. The plant need be no more expensive than a chlorine gas generator in an old-time chlorination plant.

Under average conditions hydrogen sulphide gas can be generated for two cents per pound, or less, and as a pound of the gas will precipitate nearly one pound of copper as copper sulphide, the cost of depositing the metal from cupriferous solutions will be approximately 2¼c. per pound of copper. But there is this difference as compared with iron precipitation: the acid combined with the copper is conserved and in condition to treat fresh ore.

Copper sulphide when deposited from aqueous solution is a slimy black mass, which settles rapidly. Pure copper sulphide contains 66.5% copper; but that resulting from metallurgical operations, when unwashed, carries from 52 to 58%. When filter-pressed the cakes of copper sulphide are reported to retain 48% moisture.

Copper sulphide precipitate can be air-dried and shipped to a smelter, or it may be smelted to metallic copper in a small reverberatory on the ground. A method has lately been devised by means of which copper sulphide deposited in settling-tanks may be drawn off through a pipe and treated without drying or filtering. The final product may be metallic copper, if desired. In this treatment the sulphur is recovered in a form that can be used for making hydrogen sulphide gas, and the copper can be metallized for about two cents per pound. Recovery of the sulphur reduces the figure (2¼c.) mentioned above as the cost of depositing the metal as copper sulphide.

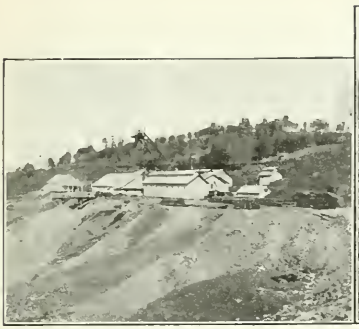
Based on the data given, the cost of material consumed, in treating ore when the hydrogen sulphide method of precipitation is employed, should be approximately as follows:

	Cost per pound of copper.
Acid consumption one pound (combined with bases other than copper)	$0.015
Hydrogen sulphide one pound (from this deduct sulphur subsequently recovered)	0.0225
Freight and treatment (same as for iron precipitate)	0.03
Total	$0.0675

These figures are comparable with the $0.12 cost given as part of the expense of the iron precipitation method.

A copper-leaching plant using the hydrogen sulphide method of precipitation is nearly as simple in construction as one using iron precipitation. A couple of additional tanks for precipitation and settling, and an inexpensive gas-generator, take the place of the iron-precipitation boxes. There are no patents in force covering the precipitation of copper by hydrogen sulphide gas: the method is an old one. Conservation of the leaching acid is the principal advantage.

When the crude precipitate is shipped to a smelter the expense of precipitation in either case will be about the same with average cost of materials. Under conditions where generation of hydrogen sulphide is inexpensive, and iron is difficult to obtain, results may be much in favor of the hydrogen sulphide method. When the copper sulphide is treated locally, the cost of hydrogen sulphide may be reduced through conservation of the sulphur, and a saving in refining charges may be effected in addition.



Bunker Hill Mine.

Concrete Magazine, with fire-proof and bullet-proof door, which complies with the law on storage of explosives.

Bunker Hill Mill.

Safety in Mining

Public hearings to consider mine safety rules were held in San Francisco on June 11 and 12, on the initiative of the Industrial Accident Commission and the U. S. Bureau of Mines, the latter being represented by Mr. H. M. Wolffin, who had recently made a tour of the mines of this State. In the course of the discussion, upon the phrasing of these rules, the mine managers present contributed a good deal of information of practical importance. We have selected such portions of the record as seem likely to be useful to our readers.

The factor of safety in the strength of hoisting ropes provoked a long discussion. In the tentative rules the factor of 5 was adopted, but an increase to 8 was suggested. The lower margin is that adopted by rope manufacturers; the higher one would entail expensive changes and enormous inconvenience to the owners of mines. One veteran engineer said:

"Increasing the factor of safety of ropes from 5 to 8 will involve a large expense. The factor of safety of 5 has been the custom so long that hoisting-engines are designed for ropes of this strength. In many cases changing the factor of safety will mean changing the drums in order to put on larger ropes, and in the case of deep shafts it will increase the weight of the rope to such an extent that the capacity of the engine will be cut in two, making it impossible to hoist the ore necessary to keep the mills going without buying an entirely new hoisting-engine. If you will figure out the size of rope necessary for, say, a 4-ton net load, weight of skip 5000 lb. and 5000 ft. of rope; for the factor of safety of 8, you will find that the weight of the rope increases so fast that it is impossible to comply with the rule. This is taking the breaking-strain as given in the tables for plow-steel hoisting-rope."

Another manager said: "Hoisting-drums in the Lake Superior country, where they have shafts 5000 ft. deep, could not possibly operate under a factor of safety of 8. The Red Jacket shaft, which is 4900 ft. deep, handles about 17 tons dead load, that is, the weight of the rope and skip. It has $1\frac{1}{2}$-in. rope with a breaking-strain of about 100 tons. That is a fraction over the safety factor of 5. They have had no accidents in their shafts due to the breakage of ropes there since the deep shafts have been put into use. There are 4 shafts deeper than 3000 ft., 3 shafts over 4000 ft., and 2 over 5000 ft. At the Sacramento shaft of the Copper Queen mine, a net load of 13,000 lb. is hoisted on a 4400-lb. rope made of $1\frac{1}{4}$-in. crucible-cast steel. This gives about $8\frac{1}{2}$ tons dead load; a $1\frac{1}{4}$-in. rope has a breaking-strain of 47 tons, so they are operating at a fraction over the safety factor of 5."

Several experienced managers testified that they had been operating for long terms of years under the lower factor (5) without any breakage of the rope. Reference was made to Hans Behr's paper on deep winding on the Rand and he was quoted as saying that the factor of safety in force would limit operations to a vertical depth of 5500 ft., because the weight of the cable would become unmanageable. In specifying for the new electric hoist to be erected at the Plymouth mine, a factor of 7 has been given. It was suggested that the time of service of the rope should be considered; that any rope is seldom in use for more than 18 months; and that if inspected carefully and frequently a factor of safety is introduced thereby.

The provision of overhead bars for giving men on cages an easy and secure hand-hold was adopted. But the forbidding of men standing on the top of a skip, or on the bale, raised a protest. One engineer insisted that "in an inclined shaft the best place to ride is to sit on the bale and put your feet on the lip." That the placing of boards on the top of skips is a common practice and one devoid of danger, was urged by more than one manager. To this it was retorted that it was inconsistent with the effort to enforce the rule providing for enclosed

cages in shafts. Whereupon another engineer suggested that the regulation should limit the number of men rather than prevent anybody from riding on boards properly laid on top of the skip. The limitations proposed was one-half the total capacity of the skip. This would allow skip-tenders, shift-bosses, superintendents, and the like, to ride up and down without having to attach the enclosure that is used while changing shifts.

The regulation that a man must stand on the skip when giving the signal aroused objection. If the bell-rope broke, the man might fall into the shaft. If it broke before the signal was completed, the man might be hoisted onto the dump. However, he can ring three before he gets into the skip, and then he rings one. The bell-cord system is yet largely in vogue in the West, although the electric-light method is displacing it. The telephone system, which is still better, is gaining ground over both the others. On the whole, the objection to this regulation missed fire.

In regard to ladders, it was agreed that the rungs should be at intervals not to exceed 14 inches and that the permissible variation should be one inch. A space of 3 inches between the rung and the wall or timber behind the ladder was accepted as convenient, the ladders being made usually of 2 by 4-in. stringers countersunk for either the whole or a portion of a 1 by 3 or 4-inch piece.

To prevent the making of dust in drilling, a regulation was drafted for the compulsory use of a water-jet spray instead of respirators. Objection was raised. It was stated that "the miners will not use the spray that is provided." They will use the respirators to prevent themselves from inhaling the dust, but not the sprays that stop the creation of dust. The Bureau of Mines representative agreed in part, but stated that where drills with hollow steel (the water being forced through the steel) are provided, there seems to have been some success in getting the men to use them. In Government work it has been found quite as difficult to get the men to use respirators, which are uncomfortable, as to use the dust-laying devices. The extra cost of using the type of drill mentioned was asserted to be "at least seven times" that of the 'stoper' used in most of the California gold mines. The necessity for employing a bar or column with the hollow-drill type makes its use much less flexible. To this one of the managers replied thus:

"We tried to use the water-spray with the hammer-stoper, and the men threw it away. We also tried to introduce the respirator. Some used it and some did not. Our particular conditions, at Grass Valley, make the Water-Leyner type of drill the most efficient because it is better for us to mount the machine on a column than to use the hammer-stoper. We also found the Water-Leyner machine is more expensive to operate per shift. It costs us about $6.25 per shift to operate a No. 8 Leyner as against $3 per shift to operate the hammer-stoper. But as we have a flat-dipping vein, the stoping conditions make the Water-Leyner type of machine the best for our purpose. We have had no luck at all with the water-spray, and very little with the respirator."

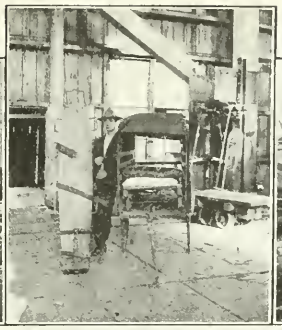
Another manager replied: "This rule more than any other threatens the future of the mining industry. It practically forbids the use of the stoping-drill, the most efficient rock-breaking machine under some conditions that has ever been built. Dust is unpleasant to work in and if the rock is highly silicious it is unquestionably injurious to health; but respirators can be made, and are made, that will absolutely prevent any dust passing into the lungs. A rule compelling the men to wear such respirators will have the effect which the Commission desires to accomplish in protecting health, without inflicting a burden on the mining industry, that in some cases will threaten its existence.

"In regard to the respirators, we have some dusty places in the mine, and the men for a number of years past have been buying and using respirators of their own accord. We never made any regulation about it or even suggested their use. They buy them and use them and are perfectly satisfied.

"Another difficulty and expense is the use of water. In many cases it is difficult to have water piped into the stopes. You have to have a second pipe-line that has to be taken out every time there is blasting, which means double operation in getting ready. Another objection to the column type of drill, either with water or not, is in the placing of it. This operation requires half an hour to an hour and one-half, depending on the character of the place, whereas the stoper can usually be set up in a few minutes. It is extremely efficient in hard ground, and has made, I believe, the fastest drilling record. Compared with the others, the labor is quite high, and it requires a better type of miner to operate efficiently than any other kind of machine. We have been testing these machines recently, and I think I do not exaggerate in stating that if this rule is passed, the use of the respirator prohibited and the use of water-spray made obligatory, it will threaten the existence of the mines on the Mother Lode."

To this the representative of the Bureau of Mines replied: "In mines where the stoper is used the ground is very hard and they have discarded all piston-drills or will discard them as fast as possible in favor of the Leyner. In stoping with this form of machine, while not always possible with the present construction of the machine to use it economically in California mines, it is possible under some conditions to use it more economically than the hammer-stoper. The Homestake Mining Co. has made extensive tests and has decided to use the Leyner drill because it is more economical. In regard to the hammer-drill also, the dust is hard on the men. I have seen surgeons of the Bureau of Mines examine men who were working in dry mines with these hammer-drills and find evidence of silicosis in over 35% of the men examined, that is, one man out of every three was affected. The respirators, while they will answer the purpose, if worn, are very uncomfortable, for I have tried to wear them myself over periods of several months and know what the discomfort is. Furthermore, if some reasonable

Unguarded Collar of Incline Shaft, Showing Inflammable Material Piled Near-by.



Stretcher Used at the Homestake Mine.

Carelessness in Not Replacing Guard-Rails at Top of Inclined Shaft.

dust regulation is not made at the present time, I think it likely that a more drastic regulation will be introduced at the next Legislature, and we cannot at that time stand between the operators and the men."

Many managers testified that the men would not use the spray, while some of them would use the respirators. Another manager made this appeal to the Commission:

"We have tried and made some elaborate tests on hollow-steel drills. On account of the hard rock we found the cost of stoping absolutely prohibitive. If it is necessary for us to put in the hollow-steel drills, it will mean closing-down as soon as the law goes into effect. While it will not work much of a hardship on the company, it will on the community."

In the end the rule was modified allowing of "other means equally efficient to prevent the inhalation of dust." The respirator won.

Objection was taken to the use of the canvas stretcher, especially where an injured man is to be carried down a raise or manway of small size. Instead, the managers approved a wooden stretcher, provided with straps to go around the body, a foot-rest, and an iron hook at the top whereby the stretcher with the injured man firmly attached can be suspended and easily lowered through any vertical opening. The main part is a board about 12 to 14 inches wide. Any carpenter can make it. The Homestake mine supplied the model.

It was agreed that 'a 'leaser' is not the same as a 'lessee,' that the ordinary legal significance of the latter does not apply to the man who has limited rights to work in a part of a mine under strict conditions. A 'leaser' is an employee; a 'lessee,' a tenant not subject to orders but operating on his own account.

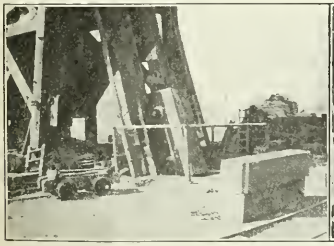
The use of grease or oil to water-proof joints between cap and fuse was condemned, as causing misfires and otherwise dangerous. Instead, roofing paint was recommended for this purpose. Also ordinary white laundry soap.

It was the opinion of many that it was safer to ride on a loaded skip, being more likely to stay on the track, than on an empty skip, in certain mines where the factor of safety of the rope is ample, and the track is somewhat rough, or where the construction of the skip is such as to admit of the possibility of its being overturned when empty. Ordinarily, of course, it is not considered safe to ride on a loaded skip because of the danger of falling off, and the probability that if the rope breaks it will do so when under the strain of the load.

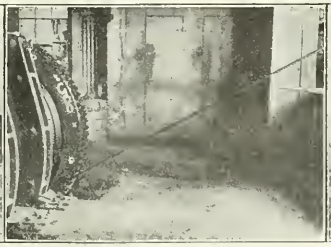
All injuries or accidents, it was decided, should be reported before going off shift, because many slight abrasions and hurts become serious, especially in coppery water, if not given medical attention.

The shift-boss received proper recognition, it being agreed that reports concerning conditions underground, such as dangerous places and the like, should be reported to him. In many rules the shift-boss was coupled with the foreman.

It was suggested that no man should 'spit' more than 15 fuses at one time without another man to assist him. On the other hand, an opinion was expressed that there are many miners who get excited when a fuse does not ignite quickly, and when they have to cut it again to



Shaft-Guards in Place at Collar of Incline-Shaft.



Unguarded Hoist-Drum and Rope.

Inflammable Mill-Building Close to Shaft that is an Intake Air-way.

make it 'take' they lose their heads. It depends upon the position of the working-face, that is, the facility for an easy exit to safety. In a drift a miner can spit 15 or 20 fuses comfortably, but in the bottom of a winze, where escape means the climbing of a chain-ladder, and so forth, 5 fuses would be enough.

Testimony was given that in firing holes surer results were obtained with fuse than with electrical firing. Also that the use of the lighting circuit was more satisfactory than a battery.

As to returning to a place where a charge has been exploded, it was held that in a well-ventilated mine an interval of 15 minutes would suffice to ensure the escape of fume and also the danger of missed holes; but it was stated that the Bureau of Mines had a record of shots that went off three hours after the fuse was 'spit,' and even longer. Forty minutes was suggested as a compromise.

The use of shower-baths in change-houses has decreased many kinds of infection, where the men have been persuaded to use them. It was argued, however, that a change-house it not a 'place of employment' and that therefore the use of either the change-house or its shower-bath could not be made compulsory on the men nor the providing of it compulsory on the mine-owner. It is a place to which the miner goes *after* he has done his work. On the other hand, the change-house and its conveniences minister to the 'welfare' of the worker and to the ability of the owner to restrict the stealing of rich ore. The 'place of employment' is the employer's premises, where the workman is under the authority of the employer. Therefore this comes under the jurisdiction of the Industrial Commission or similar authority.

In regard to oil underground, it was agreed that the quantity did not matter so much as the place where it was kept. As one manager said: "If the oil is kept in a place distant from timbers and is not likely therefore to leak and soak into the timbers and catch fire, the quantity cuts no figure. The oil itself is not readily inflammable, but it is the timber soaked with oil that is inflammable."

The question arose as to whether dynamite should be carried on a car next to an electric locomotive underground. It was suggested that the dangerous load should be placed on a rear car, that an empty car should intervene, or that a long coupling should be used, so as to keep the dynamite-car away from the trolley and prevent a vagrant spark from dropping on the dynamite. A regulation might be framed providing that the dynamite-car should be separated from the locomotive by a fixed distance. The question was left undecided.

Red wrappers are used on dynamite cartridges at many mines. It is claimed that the red wrapper is more effective in making cartridges visible and in aiding the detection of them in broken ore than the brown. The companies supplying explosives do not charge extra for the red wrapper now, but they used to charge $\frac{1}{2}$ cent apiece. Owing to the War and the scarcity of aniline dyes, the supply of these red wrappers has run short, but this is to be corrected by the end of the current year. It was stated that the red wrapper was adopted during the driving of the Simplon tunnel. It was found to lessen accidents. Then it was introduced at the Mammoth mine, in Shasta county. As the manager of that mine said: "It is much more easily distinguished in broken ground, and in the faces where the powder remains in the drill-holes you can see the red wrapper 20 ft. away, but with the other wrappers it was not unusual for men working in the face not to know powder was there."

The use of water on burning 'powder' tends to increase the danger, according to the chemists of the Bureau of Mines. Incidentally, it is noteworthy that 'powder' is used as a synonym for dynamite, thus perpetuating a term inherited from an earlier period when sporting powder was the usual explosive.* Among fire-extinguishers, those using pyrene were mentioned as less dangerous than those using soda and acid, the latter being on a par with water. Sand was said to be used in Arizona to extinguish dynamite fires, but no faith was expressed in this method.

Signs to indicate where blasting is in progress outside regular hours are desirable. It was suggested that "the time of all blasting and firing shall be fixed by the superintendent, and notices giving the times of firing shall be posted in prominent places at the entrance of the workings, and at the various shaft-stations. No firing shall be done at other than the stated time unless all entrances to the working place are guarded by men or by placing in the 'traveling ways' signs of warning or red alarm lights. Such protection shall be given at bottom of raises and at the top of winzes, and also in the working-levels."

The relative merits of strap-iron and T rails were debated. Opinion was evenly divided. For incline-shafts the strap-iron was especially suitable. It was recommended in shafts where the live load is less than 4000 pounds and the rope-speed not over 300 ft. per minute, provided that the strap-iron is bolted through the stringers. It is easier to make an inspection of a shaft with T rails than of one equipped with strap-iron. If the end of a strap is loose, it is discovered only when the skip passes and is jarred. A loose bolt is not readily detected by looking under the track. One engineer asserted that heavy iron, such as $\frac{5}{8}$-inch, properly bolted, was as safe as any T rail. Frederick Hellmann, formerly manager of the East Rand Proprietary, was quoted as having stated that the best installation for a rope-hoist in an incline shaft consisted of longitudinal stringers equipped with heavy strap-iron. The Tennessee Copper Co. was said to hoist 3000 ft. on a 75° incline, using strap-iron made to conform to their design. It was complained that to forbid the use of strap-iron would be a hardship to small operators, especially those at a distance from the railroad or from wagon-roads.

Any visitor to the hoist-room must remain in sight of the engineer while the hoist is in motion. This refers to officials who have some business there. It makes the

*See Mr. E. G. Spilsbury's reminiscences in our issue of July 10, page 42.—EDITOR.

engineer nervous for anybody to come into the room and get behind where he cannot be seen. It was suggested that all visitors be excluded.

Marked difference of opinion was elicited in regard to the use of wood and pipe rails as against chains, for guarding the approach to a shaft. The weight of one and the sagging of the other were given as defects. It was argued that a chain was easy to detach and throw aside when necessary, while a wooden bar is heavy, especially when wet. When employing a pipe-railing it is usual to have a centre-post, which gets in the way when timbers are being loaded. If the centre-post is removable, it may fall into the shaft. On the other hand, the chain must be loose in order to allow play for hooking it; then it sags and may cause a man to trip. If tight, it is difficult to hook and the men leave it unhooked. The guarding of shafts, it was agreed, was so important that the matter was referred back to the committee.

PRODUCTION of crude borate materials in the United States in 1914 was 62,400 short tons, valued at $1,464,400, compared with 58,051 tons in 1913, valued at $1,491,530. This is an increase in quantity of 7½%, according to Charles G. Yale and Hoyt S. Gale, of the U. S. Geological Survey. All the crude borate material now used in this country is the mineral colemanite. The product during 1914 was obtained from three mines, all in southern and southeastern California. The larger part came, as usual, from the Lila C. mine of the Pacific Coast Borax Co., in the mountains of the Death Valley region of Inyo county. During the year this company completed a calcining plant at Death Valley Junction to roast the lower-grade ores before shipping them to New Jersey to be refined. It also completed a narrow-gauge railroad from the Tonopah & Tidewater line at Death Valley Junction to the Biddy McCarthy and Monte Blanco mines of the company in the Furnace Creek region, which have not yet been operated. The Sterling Borax Co., near the border of Los Angeles county, was second in production. Two grades of ore are mined. They are roasted to remove impurities. On calcination the colemanite content of the ore is dehydrated and becomes a fine powder. The Stauffer Chemical Co., of San Francisco, which was once interested in the borax mines at Lang, has obtained a controlling interest in the holdings of the Russell Borate Co. in the Ventura district. This company hauls the ore 35 miles to rail and ships it to San Francisco for refining. The season is limited to about seven months in the year on account of heavy roads in winter. A 40-ft. deposit of colemanite is reported to have been discovered at a depth of 370 ft. by ranchmen drilling for water about four miles from Rich station, in the Kramer district, San Bernardino county.

SALT PRODUCTION of the United States in 1914 totaled 34,804,683 bbl. of 280 lb. each, equal to 4,872,656 short tons. This was valued at $10,271,358. The output was an increase of 405,385 bbl. Imports were 934,319, and exports 587,818 bbl., a decline and increase respectively.

Leaching Slime Tailing

By LAWRENCE ADDICKS

*In devising a scheme of metallurgical treatment for the ore of the Burro Mountain mine, it was at first planned to subject the ore, containing 2.35% copper, to preliminary concentration, yielding a tailing of which one-half was sand containing 0.3% copper, and one-half slime containing 1% copper. Before the experimental work was completed it was found that flotation would yield a tailing too low in copper to justify re-treatment, but the research was completed in order to have the data on record.

The first step was to separate the solid material from the thin tailing pulp. It was first thickened in a standard Dorr unit to a consistence of 1 to 1. This thickened pulp was then run into shallow basins where it was allowed to settle and dry by evaporation; the tests indicated that it could be thus dried down to 10% moisture within a reasonable time. Material containing 25% moisture was also dried in a 7 by 31-ft. rotary kiln, using oil for fuel. The results with this indicated that ½ gal. of oil must be burned for each unit of moisture in the material to be dried. It was necessary to provide means for crushing any lumps formed, otherwise they would be burned hard in the subsequent roasting.

The roasting was done in a standard 6-hearth 18-ft. MacDougall furnace. Roasting at the rate of 100 tons per day, 3½ gal. of fuel oil was burned per ton. The proper roasting temperature lay between 900 and 1100° F. The slime before roasting averaged 0.84% copper, and the calcines averaged 0.74% copper. It is thought that this was due to the formation of anhydrous copper sulphate, which was carried away with the flue-dust. The hot calcine was discharged into a sloping trough containing a 3 to 4% solution of sulphuric acid. It was found that 90% of the copper extracted by leaching was taken into solution during passage through the trough. The removal of the dissolved copper from the slime was a difficult problem. Continuous counter-current decantation with Dorr thickeners was finally adopted. Some changes in design were necessary, but the equipment, on the whole, proved practicable. The chief difficulty was with the air-lifts, and a diaphragm pump was substituted, with complete success.

The liquors during the run accumulated sulphates corresponding to 10 lb. copper, 4.3 lb. iron, and 16.2 lb. alumina, the consumption of sulphuric acid being 49 lb., per ton of slime leached. The acid equivalent of the metallic oxides is 70.5 lb., showing that a good deal of sulphate is present in the calcine. The run was not long enough to determine whether the impurities were dissolved in increased amounts as the liquors became more concentrated. The experiments indicated that an extraction of over 70% of the copper present in the slime could be maintained in practice.

*Abstract of a paper to be presented at the September (San Francisco) meeting of the American Institute of Mining Engineers.

Joplin and the Spelter Boom

By OTTO RUHL

The whole zinc industry of the United States has been growing more prosperous for the last 10 months, arousing the interest of everyone connected with the business or in the least affected by the rapid changes in prices. It is not clear just where the final adjustments will be made, hence differences in opinion as to the future are not surprising. It does seem fairly clear, however, that whatever the final adjustments may be in the foreign countries producing zinc, the American spelter industry, both from a mining and smelting point of view, has bright prospects for some time to come.

The effect of these changes on the Joplin mining district, the largest single producer of zinc ores in the United States and the largest producer of high-grade concentrate in the world, forms an interesting chapter in current history. The demand for spelter of the grade necessary for making brass for munitions naturally fell to those concerns whose product came principally from the smelting of high-grade zinc concentrate. The effect of this demand was felt on the Joplin market immediately after the declaration of war and the over-running of Belgium by the Germans. England needed spelter, and, finding it impossible to obtain it from former sources, turned to the United States. Prices for concentrate jumped from $38 and $40 to $50 per ton in Joplin; and thus began one of the greatest eras of production the Joplin district has ever known.

Following the long period of low prices in 1913 and in the first half of 1914, there had accumulated in the bins of Joplin producers surplus stocks amounting to 12,000 to 18,000 tons of concentrate. Simultaneously the rate of production had fallen to approximately 5000 tons per week, the major portion of which was coming from the smaller mines and richer ore deposits, from which profits could still be obtained even in the face of low prices. The large 'sheet-ground' areas were full of idle mines and mills; and these were the properties, too, from which come the large weekly outputs. Another singular condition was the fact that in the thin sheet-ground areas there were still standing some of the mills that had become monuments to the failure of concerns that had attempted to work ground containing less than 2% zinc. On a $40-market they were colossal failures: with a $75-market they offered opportunities for quick and large profits, because the development work was all done underground and the only expense was the repair to the plants before production at capacity was possible. As the zinc smelters turned to the Joplin district for their needed supplies of high-grade concentrate, they found there large surplus stocks to draw upon, a steady weekly output of 5000 tons, and, with an increased price, a potential output of 1200 to 2500 tons weekly.

The rapid increase in demand for 'brass-special spelter' soon used stocks of high-grade concentrate held by most of the smelting concerns, and caused those whose products had been confined to ordinary grades from mixed and low-grade concentrate to change their practice to turning out a better quality of spelter. Some smelters that had been taking large tonnages of low-grade concentrate restricted their contracts to the minimum, accumulated product in stock-piles, and began the purchase of high-grade concentrate and the manufacture of spelter suitable for brass-making. This action again was reflected in the Joplin district by an increased demand, and prices began to soar.

The only action looking toward the greater use of low-grade product was the importation of 14,000 tons of Australian concentrate, which was purchased on unusually good terms for the smelters, and did not realize sufficiently good returns to the sellers to induce them to repeat the experiment. Since then the tendency has been toward the use of high-grade concentrate wherever it is possible to obtain it.

In adition to the desire for concentrate of high-grade for making a good brand of spelter, the desire for maximum capacity on the part of the smelters has led to the increased demand for Joplin 60% zinc concentrate. A zinc silicate or carbonate product must carry 40% to be acceptable, while a sulphide carrying less than 50% is not being sought. Thus while many Western mines capable of producing a large tonnage of 40 to 50% zinc concentrate are finding that they cannot market their product, the demand upon the Joplin district is constantly increasing.

Responding to this demand, the Joplin district during the first six months of 1915 has shown a weekly production of 6230 tons of zinc concentrate, equivalent to 325,000 tons annually. Of this nine-tenths is sulphide that will average 57% zinc, and the remainder calamine that will average 40%. This shows an increase of approximately 20% in output for the half-year. It is safe to say that the momentum of increased activity due to increased demand and prices is just now at the point where it is being most felt, and the results are certain to be made more manifest in the second half of the year.

Practically all the mines in the 'sheet-ground' that are normally classed as going concerns at normal prices of $40 to $45 for concentrate are now working at full capacity. Every 'soft-ground' property capable of production at normal prices is also working at full capacity. When it became certain that the period of high prices had come to stay for the period at least of the war, those 'sheet-ground' mines, previously mentioned as "colossal failures," but now potential profit-makers,

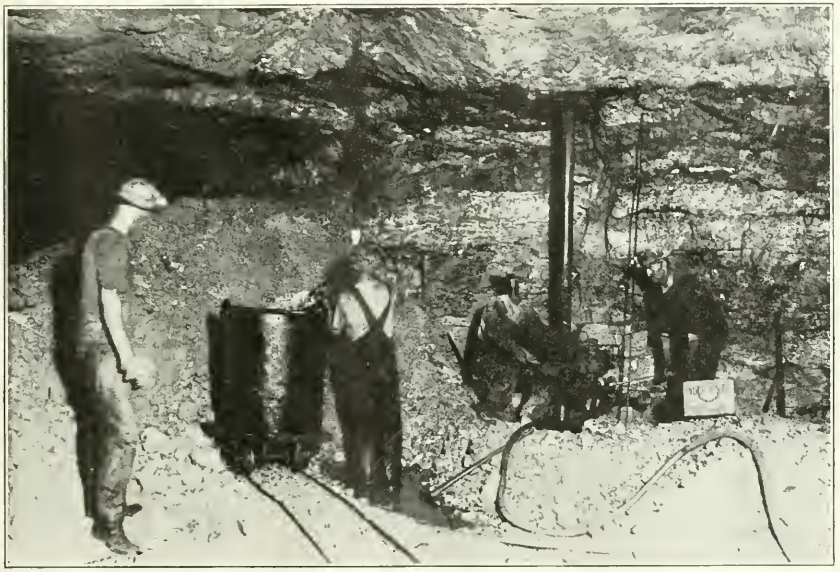
received attention. They are beginning to show in the production columns and before the year ends there will be a much larger list of active properties of this class. Their life, of course, will be confined to the period of high prices.

With a possible demand of 220,000 tons of export trade in spelter, the major portion of which will be for 'brass-special spelter,' there is no decrease probable in the demand that will be made upon the Joplin district for its high-grade concentrate until the end of the War. Granted that only half of the 220,000 tons was for high-grade spelter, the normal domestic use for which in brass-making is over 60,000 tons per year, this would consume more than the spelter possible to manufacture from the Joplin district concentrate, even if it yields 325,000 tons this year. When it is taken into consideration that the normal use will be enormously increased on account of the tremendous orders for American munitions and automobiles, the outlook is indeed promising for some time to come.

What is worrying the Joplin ore-producer more than anything else at the present time is the division, between the mine-owner and the smelter, of the profit represented in the increased price of spelter. Taking the price of spelter at 19 cents per pound, a ton of Joplin 60% concentrate yields approximately 1050 lb. spelter valued at $200. For this ton of concentrate the producer obtains about $90. It costs the smelter $14 to smelt it and put the metal upon the market, leaving a profit of $96 to the smelter. On the other hand, it costs the producer in the neighborhood of $40 to put the ton of concentrate in the bins, leaving him a profit of $50 per ton. While the producer is glad to have a profit once more, he is inclined to believe that the division ought to be nearer 50-50 than it is.

The rapidly increasing smelting capacity, as announced by the new additions to operating plants, and the building of new ones, is being viewed by the Joplin ore-producer with a great deal of joy, for it means a constantly better division of profit. Once the smelting capacity is established on a competing basis, the demand for concentrate will naturally effect a better relation between the profits of the mining and smelting ends of the industry.

On the other hand, the miner's fears are centred upon the building of a tide-water smelter that would utilize the zinc concentrate from Australia for re-export trade, and the resumption of imports of zinc ore from Mexico on a large scale following a settlement of the revolutionary conditions that have heretofore acted as a prohibitive tariff against that country.



IN A SHEET-GROUND MINE AT JOPLIN, MISSOURI, ORE AT 200-FT. DEPTH. NOTE THE 1000-LB. CAPACITY CAN USED THROUGHOUT THE DISTRICT.

Reduction of Manganese Ores. The reduction of manganese ores in a blast-furnace can be done directly or indirectly, according to H. Thaler, in *Oesterreichische Zeitschrift fur Berg-und Huttenwesen*. The furnace must be run hot in order to get the most favorable conditions for reduction and the fuel consumption increases with increase of the manganese content of the furnace charge. The slag contains 8 to 10% Mn and its basicity should be 0.8 to 1%; the loss of manganese by volatilization amounts to 7 or 8% in a 20% spiegeleisen. The ratio of silicon to manganese must not be too high, or reduction of silicon takes place.

Concerning Rock-Drills

By P. B. McDONALD

In *The Engineering Magazine* for July Mr. L. O. Kellogg contributes an 18-page discussion on 'Rock Drills in Mining.' This really tells what mining men would like to know about rock-drills, instead of the platitudinous pedantry of dry trivialities that discourages the reader in the customary article on the subject.

For the benefit of those who do not see *The Engineering Magazine*, the following condensed extracts are offered with a comment or two.

"On any particular job of shaft-sinking, driving, or stoping, it is often possible to get nearly as cheap results by hand work, particularly in remote situations, in the softer rocks, or at temporary jobs and doubtful prospects." [I would add here: where good hand-drillers are plentiful and not too high-priced. There is an English copper-mining company that has operated successfully by hand-drilling along the remote Newfoundland coast for two generations. It would not be difficult to bring coal for power-drilling from Nova Scotia by boat, but there is labor available for hand-drilling that is capable and cheap.] "Within only a few years large and important shafts have been sunk entirely by hand. Still, the machine-drill has considerably reduced mining costs by the indirect methods of making it quicker and easier. It has doubled the speed of sinking, quadrupled the speed of driving, and increased the tonnage broken per driller five or ten-fold. Next to the mine-pump the machine-drill has made modern mining modern."

"No gasoline or electric-drill has proved thoroughly satisfactory, although electric-drills are possibly successful in coal mining."

"The Leyner was the first American hammer-machine to make any great stir, and was developed in the West. It [the Water-Leyner or Leyner-Ingersoll] is especially available for flat holes, being not very widely used for shaft-sinking, since in such work the hole-bottom is not kept so clean and there is a loss in efficiency. In raising or in stoping where approximately vertical holes are required, not only is the [water] cleaning not necessary but on the contrary the sludge has a tendency to run down into the machine and make trouble." [The Calumet & Hecla uses Leyner-Ingersolls in inclined raises of about 40° where 'stopers' are not so convenient as in vertical raises.]

"The stoper followed the Leyner. The first machine consistently successful in this country was the Waugh, also a Western product. For over-hand stoping and raising, the stoper [essentially an unmounted, air-feed, hammer-drill] is the most highly efficient machine yet devised. Valveless stopers, such as the Ingersoll-Rand Imperial, are not gaining in popularity. It is simpler than a valve-actuated stoper, but less efficient and wears more rapidly." [Simplicity is a whole lot, but so is wearing quality.]

"The first automatically rotating stoper on the American market was put out by the McKiernan-Terry Drill Co. The second by the Cleveland Rock Drill Co., which type represents the most advanced design of any stoper, has a throttle-valve so arranged that in soft ground the rotation can be made rapid but the hammer-stroke light, while in hard ground, hard hitting can be obtained with any desired speed in rotation; that is, the rotation and the drilling hammer can be operated separately and at different speeds. Despite, however, this desirability of control and flexibility, such a type of stoper weighs much more than a hand-rotated stoper of the ordinary sort. Automatic rotation of stopers is an advantage when the hole is somewhat flat and the cuttings, not falling out readily, bind the steel in the hole. It is easier for the miner." [Under ordinary conditions it is not much of a bother for a miner to rotate a stoper by swinging by hand, especially as he hasn't to feed the drill ahead—the air doing that—and it rather keeps him awake. However, for inclined holes in irregular ground, the Cleveland machine is undoubtedly a blessing.]

"It is not unlikely that a stoper style of drill may establish itself for driving, using water and air to clean the hole, and differing from the Leyner essentially only in having air-pressure feed instead of hand cranking." [Possibly a plugger type rather than a stoper type for driving will evolve, so that 'push' feed by the miner will replace hand-cranking or air-pressure feed, obviating cumbersome rigging-up except 'fish-pole' mountings or rope suspension.]

"The first automatically rotated plugger to score any considerable success was the Jackhamer of Ingersoll-Rand, although the honor of putting the first machine on the market probably goes to the McKiernan-Terry Drill Co. The Cleveland 'Mucker' possesses the same separate engine and valve as the Cleveland stoper. The Ingersoll-Rand 'Bull Moose' is seemingly much like the 'Mucker' in construction." [Who selects these attractive names?].

"The quality of the drill-steel has not kept up to the progress in drills; particularly does drill-steel show up weak with hammer-drills. In a deep mine, it is calculated that every round-trip to the sharpening-shop for each piece of steel costs 10 to 15 cents. There is some promise in a detachable bit invented in Butte, such that a miner can carry bits for a working-shift in his pocket."

"What constitutes a good drill?

1. Speed because miners are highly paid workmen.
2. Standing-up to the work.
3. Lightness and convenience, because much depends on the miner liking his machine.
4. Low air consumption, not of so much account as the first three, because speed, etc., is more important than a little wasted air. The air-drill is an inefficient and extravagant machine at best. It uses an expensive fluid at full stroke; a 3½-in. piston machine requires when running probably 25 hp. to be taken off the motor-shaft of, say, a belt-driven compressor."

OIL PRODUCTION of Pennsylvania in 1914 was 8,170,335 bbl., averaging $1.906 per bbl. This was an increase of 253,033 bbl. but a decrease of $0.581 per bbl. in value.

An Electric Furnace for Melting Cyanide Precipitate

By W. P. LASS

*The gold precipitate from the zinc-dust presses in the cyanide plant of the Alaska Treadwell Gold Mining Co., Treadwell, Alaska, is treated, in the refinery adjoining, by the Tavener or lead-smelting method. About 3 or 4 tons of this precipitate, containing $40,000 to $60,000 in gold per ton, is produced monthly. It was formerly the practice to treat the by-products from this process, consisting of 2 tons of slag, 300 lb. matte, and 500 lb. refinery refuse, flue-dust, etc., in a 24-in. water-jacketed blast-furnace. This practice was discontinued in 1914 because of the difficulty of keeping the lead-well open when treating a high-grade lead product; of preventing the loss of gold in the flue-dust; and of avoiding injury to the general health of the refinery operators.

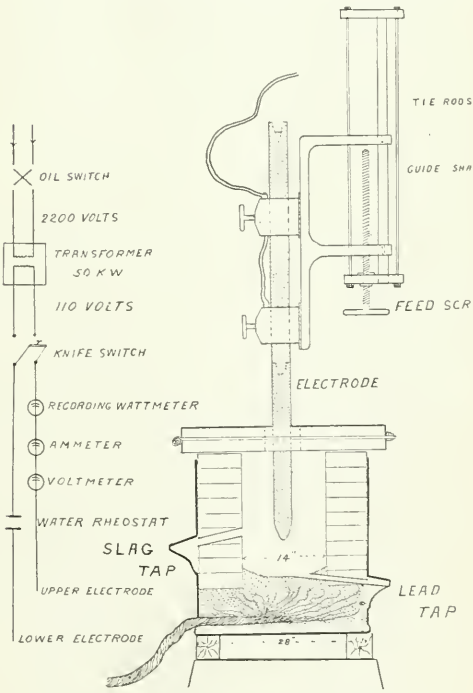
A plain single-phase electric furnace was substituted for the blast-furnace. This was constructed from an old steel acid-drum by cutting off the top and introducing a cable, made from strands of bare copper-wire, through the bottom and spreading the strands out fan-shaped on the inside of the drum. Powdered graphite, obtained by grinding old crucibles, mixed with 10% of cement, was tamped wet into the bottom of the drum, around and completely covering the copper wires. The graphite was carried up to the bottom of the furnace, or lead-well, and acted as the lower electrode. The sides were built up of ordinary firebrick, forming a melting-chamber 14 in. diam. by 20 in. high. The upper electrodes, of graphite or carbon, are 3 in. diam. and 40 in. long, arranged with joints enabling new electrodes to be connected without shutting down or wasting stubs. A screw-feed was arranged for raising and lowering the upper electrode.

The cover for the furnace had three openings, one for feeding the charge, one for the escape of gases, and one in the centre for the introduction of the electrode. It was later found more practical to enlarge this centre opening to 6 in. diam., to allow central feeding of the charge around the electrode. A 4-in. pipe connected to a ventilating fan carries off the escaping gases. The furnace is operated on the lighting-circuit through a 50-kw. transformer, 60 cycles, 110 volts. Later, a water rheostat, operated by raising and lowering one disk on another submerged in a barrel of water, was constructed to lower the voltage for use when starting the furnace, or when there was a bath of metal in the bottom of the furnace that would otherwise allow too much current to pass and thereby cause short circuiting.

The material to be treated in the furnace is mixed in the following proportions: Refinery by-products, 100 lb.; old reverberatory hearths, containing 60% CaO, 20 lb.; litharge, 20 lb.; coke, 2 lb.; scrap-iron, 3 lb. About 160 lb. of the mixture is added for a charge. The total amount of material added during the melt is 8507 lb., of which 5870 lb. is by-product material (old slag, the residue from burning old mill-launders, sweepings, etc.) of the following composition:

	%		%
SiO_2	40.1	Al_2O_3	2.0
Fe	16.0	S	3.6
CaO	16.1	Moisture	4.0
Cu	5.9		
Pb	3.0		96.4
Zn	5.7	Gold.....$1096.60 per ton	

Coke is added to the charge as a reducing agent, in sufficient quantity to reduce the lead. The charge is introduced into the top of the furnace through the central opening around the electrode, without removing the slab cover.



FURNACE FOR MELTING CYANIDE PRECIPITATE.

In starting, the furnace is operated as an arc-furnace, until it has become thoroughly hot. Then the charge, consisting of slag, brick-dust, etc., is added, the electrodes being raised as the load in amperes increases.

*A paper to be presented at the September (San Francisco) meeting of the American Institute of Mining Engineers.

until the entire chamber is filled with the charge and the upper electrode extends into the melt almost a foot. As the charge continues to melt the electrode is moved down or up, keeping the amperage reading as nearly constant as possible. The raising or lowering of the upper electrode decreases or increases the power consumption and thereby affects the amount of heat generated. At this stage the furnace is no longer operating as a simple arc-furnace, but has automatically transformed itself into a resistance type of furnace, the semi-fluid or molten charge acting as the resistant, the current passing from one electrode through the centre of the charge to the other. After the charge is in quiet fusion, which takes on an average 2 hr. 10 min., the power is turned off and the charge allowed to settle for 15 min. before tapping the slag. This allows the lead to settle, the furnace acting as a fore-hearth.

In operation, the molten lead and slag are tapped as in the blast-furnace. If the lead freezes it is melted by diverting current from the upper electrode and letting it pass through the lead, the tapping-rod playing as an arc on the side of the furnace or into the lead-tap. The operators use colored or amber glasses to protect their eyes from the glare of the electric arc.

OPERATING DATA

Total running time	128 hr. 40 min.
Average weight of charge added	160.5 lb.
Average fusion time of charge	2 hr. 25 min.
Total number of charges	53
Graphite electrodes used	1 per 24 hr.
Total power for 128 hr. 40 min	4440 kw.-hr.
Power used per hour	34.50 kw.
Power used per lb. of material fed	0.52 kw.-hr.
Power used per ton of material fed	1044.0 kw.-hr.
Acheson graphite used per hour	0.15 ft.
Material melted per hour	67.7 lb.
Material melted per 24 hr	1625.0 lb.

The only item of cost for flux is the coke, 2 lb. per 100 lb. of by-product material, or 118 lb. total, being used, since the old reverberatory hearths furnish the lime; the cupels from bullion refining, the litharge; and mill scrap, the iron. Both graphite and carbon electrodes are used, the former costing $2.95 each, and the latter $1.20. Power cost is less than 1c. per kilowatt-hour. The labor required for the operation of the furnace, including the work of charging and tapping, is one-half one man's time, when melting 1 ton in 24 hr. The furnace was constructed and put into operation by the regular cyanide-plant crew, without the aid of special electricians. The operation is so simple as to require no special training. Although the operators were unaccustomed to handling electrical equipment, no trouble has been experienced from electrical shocks, since the bottom of the furnace acts as the lower electrode, or grounded circuit.

The advantages of the electric furnace compared to the blast-furnace for melting high-grade gold slags are: A saving in mechanical loss of gold in flue-dust, because the melting is done in a quiet neutral atmosphere, instead of in a rising blast of air; the obtaining of a lower-grade slag, free from shot, by reason of the quieter melting action and the higher temperature obtainable, making a more fluid slag; the nicety of regulation of the melting temperature; the benefit to the general health of the operators.

Precipitation of Copper by Electrolysis

By R. R. GOODRICH

*In precipitation of copper from a solution by electrolysis the current should be proportional to the copper content of the solution. In completely precipitating the copper from a solution the operation is best conducted in a series of steps. Thus, for example, if the original solution contains 6% copper, it may be circulated through a series of 12 cells, the electrode area in each cell being 1, and $\frac{3}{4}$ of the copper present precipitated, the copper content of the effluent being 1.5%. This is then circulated through 3 cells, the electrode area of each cell being four times and the current density one-quarter that of the first cells. The effluent from these cells contains 0.375% copper, which is completely precipitated in a single cell with a cathode area eight times and a current density of one-eighth that of the first cells. Thus in the first cells three-quarters of the copper is precipitated, in the second set 3/16, and in the final cell 1/16. Any other ratio, such as 2/3, 2/9, and 1/9; 1/2, 1/4, 1/8, 1/16, and 1/16; or 1/4, 1/4, 1/4, and 1/4 may be used. In this way the current density may be adjusted to suit the composition of the electrolyte. It also makes possible a rapid rate of circulation of the electrolyte, which leads to high current efficiency. When using a carbon anode, depolarization, with consequent saving of power can be secured by the use of SO_2, but there is no depolarization with a lead anode. The depolarization, even with carbon anodes, does not exceed 45 to 65% of the theoretical amount; it varies with the current density, being a maximum at low current density. The method of introducing the SO_2 gas into the cell is unimportant, it should be present in sufficient quantity so that the electrolyte is saturated and some escapes from the surface. When it is present as a depolarizer a smoother deposit of copper is secured. Without its use a spongy deposit begins to form on the cathode before complete extraction is effected and there is also a rise in polarization. By the use of SO_2 the copper content of the electrolyte may be reduced to a trace, yielding a good firm cathode, without rise in polarization.

CHILE and the United States lead in the borax industry, with approximately equal outputs of borates, or boric acid, and borax, each producing from 40,000 to 50,000 metric tons of crude ores, mainly calcium borates. Turkey probably stands third in rank of production, with a reported average of 14,000 tons as boracite. Peru, Bolivia, Italy, Argentina, and India are also producers.

ELECTRIC STEEL PRODUCTION in Germany in 1914 totaled 89,336 tons; in Austria, 19,844 tons.

*Abstract of a paper to be presented at the September (San Francisco) meeting of the American Institute of Mining Engineers.

Recovery of Mercury From Amalgamation Tailing

By E. B. THORNHILL*

†In this paper on the recovery of mercury as sulphide, from the residues from the amalgamation and cyanide treatment of high-grade ores and concentrates, I shall not discuss the many reactions, chemical and otherwise, that take place in the general process, but confine myself more particularly to the methods of procedure.

I submit charts of two amalgamation-barrel charges, Fig. 1 and 2, which are self-explanatory. The flow-sheet of the high-grade and the mercury extraction plants is shown in Fig. 3.

In the amalgamation of high-grade silver ores and concentrates in strong cyanide solution, as practised in the Cobalt district, considerable mercury is contained in the residues from the amalgamation process. The greater part of this mercury is in the form of mercuric sulphide, from 5 to 10% only of the total mercury content being in the metallic state.

Attempts to eliminate this loss in the amalgamation process were made, but all resulted in a low extraction of the silver in the ore, and attention was then directed to the recovery of the mercury and from the residues.

The process developed at the Buffalo mines for this purpose consists in leaching out the mercuric sulphide with a caustic alkaline sulphide solution, then precipitating the mercury from solution with metallic aluminum. The equations for solution (1), and precipitation (2) are:

$$HgS + Na_2S = HgS.Na_2S \quad (1)$$

$$3HgS.Na_2S + 8NaOH + 2Al = 3Hg + 6Na_2S + 2NaAlO_2 + 4H_2O \quad (2)$$

Small-scale experiments showed that a complete extraction of the mercuric sulphide could be made by an 8 to 10 min. treatment of the residue with the alkaline sulphide solution. Advantage was taken of this fact in the commercial plant, by applying the solvent to the residue on the filter-leaf, as no agitation of any sort was required.

The operation of the commercial plant is essentially as follows: The residue in the pregnant cyanide solution is caked on a Moore filter-leaf of the usual construction and the cake washed free of silver solution with water. The basket is then lowered into the sodium sulphide solution and this solution drawn through the cake until the effluent shows only a trace of mercury. Usually 1 ton of solution per ton of residue is sufficient. This mercuric sulphide solution is pumped to a precipitating-tank and the mercury thrown down by adding granular aluminum to the agitated solution. Agitation is then stopped, the precipitate allowed to settle, and the clear solution decanted. The precipitate of mercury is then run into a small wash-tank by sweeping it through a hole in the bottom, by means of a raking mechanism similar to a Dorr thickener, pieces of old rubber belting being riveted to the bottom of the rakes. The precipitate is then washed with water by decantation and drawn off into a steam drying-pan. After drying, the fluid mercury and the powdered metallic portion are separated by raking the latter off with a hoe. The fluid is strained through a canvas and is ready to return to the circuit. The powdered material, containing approximately 75% mercury, is then retorted, and the mercury condensed in the usual manner.

The strength of the solvent is kept up to 4% sodium sulphide and 1% sodium hydroxide. Weaker solutions can be used with equally good results, but the quantity required was found to be directly proportional to the strength; that is, with a 4% sodium sulphide solution, 1 ton of solution would extract the mercuric sulphide from 1 ton of residue, but if a 2% solution was used, 2 tons would be required per ton of residue treated. The concentrated solution offers the advantage of less solution to handle and an economy of aluminum in the precipitation. The sodium sulphide used is the commercial salt costing $1.25 per cwt. in barrels f.o.b. cars Toronto.

The precipitant used is a waste product of aluminum-casting foundries, containing 75% aluminum, the impurities consisting of varying proportions of copper, silica, wood, waste, grease, etc., the grease being burned off before using the aluminum. About ¼ lb. of this material is used per pound of mercury precipitated.

It was anticipated that the sodium aluminate would accumulate in the solution to such an extent that some special means would have to be taken to remove it. This, however, has not been the case. Some aluminum, as hydrate, falls with the mercury on precipitation, and some is removed during the process of leaching, presumably as calcium aluminate, which collects on the filter-cake. This precipitation of the aluminum regenerates caustic soda so that the consumption of this chemical is reduced to $\frac{1}{10}$ lb. per pound of mercury recovered, instead of ½ lb. as shown by the theoretical equation for precipitation. Sodium sulphide is also regenerated in precipitation, but there is also a mechanical loss of approximately 20% of the solution used in leaching, as no water is used to recover the retained sulphide.

From May 1914 to March 1915, 37,650 lb. of mercury has been recovered at a cost of approximately 13c. per pound for labor and chemicals.

The laboratory methods of determining the mercury in

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†Abstract of a paper to be presented at the San Francisco (September) meeting of the American Institute of Mining Engineers.

the different products of the process may be of interest. To determine the total mercury (both metallic and sulphide), 0.5 gm. of the material is well mixed with cast-iron filings, free from grease, and placed in a hard-glass tube, sealed at one end, with a contraction at about 2 in. from the sealed end. The mercury is distilled off, by heating the bulb containing the charge, and condensed in the tube just beyond the contraction. After the distillation is complete, the contracted portion of the tube is heated, the bulb portion pulled off, and the end of the tube sealed. The tube containing the condensed mercury is allowed to cool, filled one-half full of 0.1% KCN solution, and 10 to 15 100-mg. gold beads added. Each bead will amalgamate with about 1 mg. of mercury. The tube is shaken until all the mercury is amalgamated; the beads are transferred to a small porcelain cup, washed with water, dried with alcohol and weighed. After retorting off the mercury, they are again weighed. From 10 to 12 determinations can be made in one hour by this method and it is accurate enough for control of operations.

When it is necessary to know the proportionate amounts of mercury as metallic and sulphide, two 2-gm. samples are weighed out. One sample is digested with concentrated nitric acid and the other with a 10% solution of sodium sulphide. The mercury in the residue from each is then determined by the method just given.

The strength of the sodium sulphide solution is determined by titrating against a standard zinc chloride solution, using sodium nitro prusside as an outside indicator.

The mercury produced by this process is of exceptional purity.

Potash salts in notable amounts have been discovered in Permian strata in Texas, according to J. A. Udden, in Bulletin No. 17 of the University of Texas. The interesting feature of these deposits is that the potash salts occur in solid form, rather than as a brine, material containing 9.23% potash being found in one well at a depth of 900 ft. and 10½% potash in another at a depth of 1700 ft. The potash occurs in a red substance resembling carnallite that contains 14% KCl. It occurs in association with beds of rock-salt, at the top of the series, suggesting that it was produced by a long period of concentration of sea-water in which the point of saturation of the potash salts was finally reached.

Brick and tile industries of the United States in 1914 produced material worth $129,588,822, a decrease of $13,707,935. The principal clay product is common brick, of which 7,146,571,000 were made, valued at $43,769,524. This was a decrease of 942,219,000. Illinois is the leading producer. The fire-brick output was worth $16,427,547, a decrease of $4,199,575. Pennsylvania leads in this product.

Air-compressor plant at Balboa, Canal Zone, produced 120,760,010 cu. ft. of free air compressed to 105-lb. pressure during May.

Radium

Production of radium from Colorado carnotite ores by the U. S. Bureau of Mines, in connection with the National Radium Institute, has passed the experimental stage in its new process and is now on a successful manufacturing basis.

According to Charles L. Parsons, who is in charge of the radium investigations of the Bureau, the cost of one gram of radium metal produced in the form of bromide, during March, April, and May of the current year, was $36,050. This includes the cost of ore, insurance, repairs, amortization allowance for plant and equipment, cost of Bureau of Mines co-operation, and all expenses incident to the production of high-grade radium bromide. Radium has been selling at from $120,000 to $160,000 per gram.

The cost of producing radium in the small experimental plant during the first few months of the Bureau's activities was somewhat higher, but not enough to seriously affect the final average. The public, however, should not infer that this low cost of production necessarily means an immediate drop in the selling price of radium. The Radium Institute was fortunate in securing through the Crucible Steel Co. the right to mine 10 claims of carnotite ores belonging to the latter, this being practically the only ore available at the time. Since then new deposits have been opened. These are closely held, and, according to the engineers employed by the Bureau, the Colorado and Utah fields, which are much richer in radium-bearing ores than any others, will supply ore for a few years only at the rate of production prevailing when the War closed the mines. The demand for radium will increase rapidly. The two or three surgeons who have a sufficient amount of this element to enable them to speak from experience, are obtaining results in the treatment of cancer that are increasingly encouraging as their knowledge of its application improves. A few more reports like that presented to the American Medical Association at its recent meeting at San Francisco will convince the medical profession of the efficacy of radium. Mr. Parsons considers that under all the circumstances that have come to his knowledge it does seem that the Government should make some arrangement whereby these extensive and rich deposits may be really conserved for the American people.

The 10 carnotite claims being operated by the Radium Institute at Long Park, Colorado, have already produced more than 796 tons of ore averaging over 2% uranium oxide. The cost of ore delivered at the radium plant at Denver has averaged $81.30 per ton. This included 15% royalty, salary of Bureau of Mines employees, amortization of camp and equipment, and all expenses incident to the mining, transportation, grinding, and sampling of the ore.

A concentrating plant for low-grade ores has been erected at the mines, and is successfully recovering material previously rejected.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Concentration ratio in the Alaska Gastineau mill is approximately 500 : 1.

Crude oil is of two kinds, paraffine base and asphalt base, and varies from 11 to 46° Baumé.

Churn-drill holes are drilled between levels at the Old Dominion mine, Arizona, to improve ventilation.

As the proportion of volatile matter increases in bituminous coals, so does the difficulty in burning the coal under boilers.

Boilers from an old stamp-mill at Silver Mountain, Alpine county, California, are being used as culverts in repairing the State highway.

Logwood is still used in wool-dyeing, as it is cheap and produces a desirable black that can only be produced by aniline dyes of a higher cost.

At Joplin, Missouri, concentrate is called 'ore'; at Black Hawk, Colorado, concentrate is called 'tailing.' Such are the vagaries of local terminology.

Mechanical stokers, by feeding coal to the grates, gradually permit of a uniform distillation of volatile gases, and hence are well adapted to high-volatile coals.

Round timber is sometimes hewed so that chute-lining may be spiked to it, but in heavy moving ground a chute of square timber stands better and lasts longer.

Stellite is a new alloy containing cobalt and chromium, well suited for fine cutlery. When hardening metals are added, it has an advantage of from 20 to 100% over high-speed tool-steels.

Sheaves and drums should be kept smooth and in alignment to prevent undue wear of ropes. The grooves should be of sufficient size so that the rope will fit easily into them without binding on the sides.

Conglomerate at the Calumet & Hecla mine requires more powder in blasting than does the amygdaloid formation. Over a pound per ton is necessary for the former, and under a pound for the latter.

Nitric-acid manufacture was begun in this country by Carter & Scattergood, of Philadelphia, in 1824. The industry did not attain any importance until 1862, when the discovery of nitro-glycerine and other high explosives opened a new field for it.

Antimony penta-sulphide, known to the trade as crimson antimony, in its commercial form contains 15 to 17% of free sulphur, and for that reason is largely used in vulcanizing rubber. The resulting product is red, but not all red rubber contains antimony.

Combined carbon increases the strength of steel up to 0.9%, after which it has a weakening effect. It decreases the ductility, toughness, malleability, magnetic power, and electric conductivity, increases the hardness both before and after quenching, and increases the brittleness.

Graphite or silica alone do not make so good a pigment as when combined. The silica of silica-graphite paint adds durability and supplies just enough 'drag' to prevent too thin a coat. Silica should be broken with the graphite so that particles of each cling to the other and do not settle when mixed with oil.

Coke contains all of the ash and about half of the sulphur originally present in the coal from which it was made. All the phosphorus of the coal is present in the coke; there are also present a considerable amount of nitrogen and water, and small amounts of hydrogen and oxygen that cannot be driven off by heat.

Dried kelp (seaweed), contains ordinarily about 15% potash, 2% nitrogen, and 1.5% phosphoric acid. It can be used as a fertilizer alone, or in the manufacture of complete fertilizers. The total fertilizer value of a short ton of dried kelp, is $6.68, in addition to the potash content, which is worth $9.07. It costs $3.83 per ton for production of the kelp.

Alundum, which is used extensively as an abrasive, is made at Niagara Falls, New York, by fusing calcined bauxite in an electric furnace. Alundum is especially efficient for the grinding of steel forgings and castings. Only the best grades of bauxite are used in the manufacture of such chemicals as alum, aluminum sulphate, and aluminum salts, as freedom from oxide of iron is desirable for such purposes.

Magnesium chloride can be separated into magnesia and hydrochloric acid by the application of heat. Many patents have been taken out for processes. The high temperature demanded, the cost of labor required in removing the residue from the furnace, and the fact that the end product is a mixture of magnesia with oxy-chloride of magnesium (the latter having no value) have so far defeated all attempts to evolve a practicable process.

Centrifugal compressors are being increasingly used at mines. They have several points of advantage, namely: no valves, plungers, pistons, heavy moving members or wearing parts; they deliver air without pulsation and in such a manner that the volume can be regulated by merely opening or closing a valve, without excessive rise of pressure; they require less receiver-capacity, little space, light foundations; wear and repairs are practically eliminated; the amount of oil and supplies used is trifling, and because of their great simplicity they can be satisfactorily maintained in operation by unskilled attendants.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

MELBOURNE, AUSTRALIA

AUSTRALIA AND THE WAR.—METAL PRODUCTION AND CONTROL.—ARRANGEMENTS FOR DOMESTIC CONTROL OF METAL SALES.—SPELTER.—IRON PRODUCTION.

One of the effects of the War in Australia promises to be a huge development in the industrial enterprise of the country. This is consequent upon the strongest force in nature, that of sympathy. And it also is a remarkable illustration of how silken cords are in reality the strongest of ties. The political ambition of Great Britain ever since the fatal mistake that led to its rupture with the United States has been to develop freedom in government, to impose no fetters on the communities that might be classed as dependencies. Consequently the spectacle is presented today of a self-governing community like that of the Commonwealth of Australia actually seeking to force the motherland to adopt a line of action that at the first glance appears to be contrary to all established British ideas of freedom.

One of the regions in which German organization was reaping its greatest triumph before hostilities began was Australia. For some reason never properly explained, the British smelter and metal-buyers failed to realize the mineral potentialities of this continent. At the outset the Briton held a grasp on the lead industry of Broken Hill and controlled the market for copper and tin, but he never took a close personal interest in Australia. Perhaps it was due to the visit of Schnabel in the early nineties that German eyes were opened to the possibilities of Broken Hill. Or it might have been that the successes attained by those who controlled the base-metal outputs of important regions in North and South America led the German house of Merton to combine its interests in Frankfort and then with a magnificent financial backing to start out to win trade in British communities. Anyway, for the past decade the British metal-buyer has been absolutely shouldered out of Australia, except perhaps in respect to tin. The houses that have been enabled to secure this domination have been the Metallgesellschaft, Aron Hirsch, Beer-Sondheimer, Goldsmidt, and some of the lesser Teuton lights. So skillfully have these firms conducted their operations that no one realized how strong was their hold until Australian sentiment determined that it would have nothing that was German. Then it was found that the Broken Hill Proprietary Co. was held by an agreement with the Lead Convention under which it had to sell through a firm in London that had co-operated in business matters with the Merton houses of Frankfort. The copper trade was discovered to be in German hands exclusively and the zinc business was regulated by three or four firms that were either absolutely German, or were German-controlled. Put into figures, the situation was that exports of from £12,000,000 to £15,000,000 were for all practical purposes in the hands of German houses or co-operating firms. This was discussed editorially in the PRESS of July 10. As this trade was steadily growing, is it any wonder that when war broke out, one of the most astute representatives of Frankfort capital exclaimed, when discussing the German war-lords: "Oh, the fools to destroy by war the victories of peace!"

The instant effect of the War was to thrust idleness on a large mining population in Australia. This arose from the existence in all the contracts for the purchase of crude ore, concentrate, and mine products of a clause suspending the operation of the contract until the termination of hostilities. The mines and the smelters were cut off from their markets and consequently had to shut-down. Thus an important problem was presented not only to the managements of the mines but to the Labor Government of the Commonwealth. The aptitude of the Britisher to rise to an emergency was soon displayed. Mines re-opened, and gradually arrangements were perfected for the disposal of the products. Here, however, the suspension clause in the agreements between the German buyer and the mines began to be the cause of great discontent. This discontent extended when it was discovered that the Broken Hill Proprietary was tied down under its agreement with the Lead Convention in such a way that it had to run

grave risks if it sold to the agents of British purchasers save through London as agents specified in its Convention agreement. When the Federal authorities learned of this, they did not waste time. Military law gives wide power; they searched the offices of high and low to find how the business was being handled and whether there was any secret trading with the enemy. Nothing unpatriotic was found, but sufficient facts were forthcoming regarding the German control of the trade to induce the Federal Attorney-General to decide not only to ask the Legislature to abrogate all contracts between Australian companies and enemy aliens, but to induce him to request the British authorities to move in the same direction when the domicile of a company working mineral land in Australia was in Great Britain. If that suggestion had been accepted there would have been an end to the whole of the contracts held by Continental firms in Australia, but the British Ministry has declined to go as far as asked. In Australia, however, the Labor Government was moved to take action, with the result today that a Federal enactment provides for the dissolving of all metal contracts with enemy aliens. To make the position still more secure, the State governments have each promised to pass a similar measure. As they are Sovereign States in all matters in respect of which they have not ceded authority to the Commonwealth, the nail in the coffin holding the contracts will be driven home very firmly.

It must not be assumed for a moment that the Continental interests involved take the situation at all kindly. Their representatives have not dared openly to resist such legislation, but the friendships they have built up, based on mutual interest with firms in London and in Australia, have proved strong. However, no voice has been raised against this legislative voiding of contracts, though such an act in itself is opposed to the spirit of freedom that is supposed to live in the folds of the Union Jack.

With this discovery of alien interests, new organizations had to be created. The first evolved was one intended to merge the smelting business of the Broken Hill Proprietary Co. at Port Pirie into that of a new concern to handle not only the lead concentrate of that company but those of the South and the North companies as well as those of any other Broken Hill mines that might care to join the new combination. Already the Zinc Corporation has come into the fold, and it is thought that other leading companies will share. At present the works have a capacity of about 4000 tons of lead per week, but they will be enlarged so that all the lead concentrates of the Broken Hill district can be treated, except those that find their way to the Newcastle works of the Sulphide Corporation. The North and the South Broken Hill companies alone can furnish over 2000 tons of 70% lead concentrate per week, and if the other companies should come in it will mean that the German houses will lose the smelting of ore and concentrate reresenting an output of over 200,000 tons of lead per annum. This metal will be marketed by the new company. That raises the question as to how the marketing will be conducted when the War is over. If Germany should win, there is little doubt as to what will be done. If it should lose, will British policy and sentiment be so strong as to compel the merged company to act away from all association with the German firms that formerly constituted the leading factors in the Lead Convention? If this happens will their American associates enter into a war of competition with the Australian company? Many people think that self-interest will prevail and that patriotism will be relegated to the dust-bin.

The zinc position is different. The only distillation works in Australia belonged to the Broken Hill company and form a part of the new Port Pirie smelter. Their capacity was under 5000 tons per annum. The zinc contents of all the concentrate produced at Broken Hill represents about a sixth of the world's production, and it is estimated that it would take between £3,000,000 and £4,000,000 to erect works capable of dealing with the output. The lives of the mines are not sufficiently assured to justify such an expenditure. So the companies have sent agents to the United States and to London to find out if the ore will be bought in those countries. It is only of late that American buyers have quoted a favorable price, but no large shipments have been made to that country, the cost of freight proving prohibitive. On the other hand, the British government has not been inclined to depart from its old established policy of non-interference with private enterprise by subsidizing the construction in England of works for the production of spelter, but there appears to be some indication of a change of policy. Of late inquiries have been made from London for zinc concentrate, and it is thought the intention may be for Britain to co-operate with France in enlarging zinc distillation works in the latter country to meet national needs. If that be done, the result may be the abrogation of contracts between Broken Hill companies domiciled in London and enemy subjects that otherwise would be revived directly war ceased.

Last, and most important, comes the iron and steel enterprise of the Broken Hill Proprietary Company. This concern has expended a large sum in erecting, at Newcastle in New South Wales, a large plant for the treatment of iron ore obtained from the Iron Knob and the Mammoth ore deposits in South Australia. Over 100,000,000 tons of exceptionally high-grade iron ore is developed here. The trade to be supplied is worth at least £7,000,000 per annum and although the company's works are not of sufficient extent to enable it to meet this business, still a most determined attempt will be made to capture it. The question that arises is whether labor, which now dominates politics in Australia, will permit one of the oldest planks in its platform—the nationalization of the iron industry—to be smashed by this private corporation. Will it try to buy the works or will it start in opposition? Whether this be done or not the world can be certain that Australian policy will be to protect the new industry against outside dumping. This, of course, will mean cutting British, Continental, and American iron-masters out of the market unless they care to come inside the tariff wall, take up iron ore deposits, and establish themselves in this country.

LORDSBURG, NEW MEXICO

Mogollon District.—New Railroad.—Lead Concentrator.—New Companies.—Wages at Chino.—Empire Zinc and Santa Fe Gold and Copper Mines.

Shipments of gold and silver bullion from the Mogollon, Socorro county, are being made regularly from Silver City. The Ernestine company has been granted a permit from the state engineer to take water from the south fork of Silver creek for a storage-capacity tank. At Socorro on July 26, the property of the Mogollon Gold & Copper Co. was to be sold at auction to satisfy a judgment for $416,626 given the Equitable Trust Co. of New York. No bid for less than $100,000 was to be considered, and the special master could postpone the sale at the request of the plantiff or a majority of the bondholders. A $17,000 school is being erected at Mogollon. It will be completed for the fall term. The roads between Mogollon and Silver City are in a deplorable condition and almost impassable in places. Several projects for new road construction are under consideration by both Grant and Socorro counties, but none have yet materialized.

By August 15 the Arizona and New Mexico railway will be hauling ore from the mines in the Virginia district, three miles southwest of Lordsburg, over the new spur connecting with the main line. Work on the grading commenced several weeks ago, and has been continued rapidly. At present the preliminary track is as far as Shakespeare. Several of the larger cuts have been completed and two bridges have been erected. The company did not let contracts, but did the grading itself. The tractors hauling ore between Lordsburg and

the 85 mine, by Rowan and Downey, will be moved to other places on the completion of the spur.

The dry concentrator at the Waldo lead mine at Lordsburg started on July 20. It is making a satisfactory recovery. The present mill is merely a test-plant, if successful a larger one will be built.

New mining companies recently incorporated in New Mexico are as follows: Southwestern New Mexico Mining Co., of Hachita, capital, $150,000, fully subscribed, incorporators are T. J. Barnes of Hachita, and J. D. Russell and J. Boyd of Sweetwater, Texas; Estrella del Norte Mining Co., incorporated by Las Cruces and El Paso men, capital, $1,000,000, A. S. Brice of El Paso is statutory agent; Lee Russel and Edward Burch of Hurley, have incorporated the Rip Van Winkle Mining Co. and will operate mines at Fierro.

The gold properties of the Wildcat Leasing Co. of White Oaks, Lincoln county, have been taken under option by Richard Wightman and associates of New York. Messrs. Stanton and McDonald completed the transaction.

The Chino Copper Co. has announced a general advance in wages of all its employees of approximately 10%. The scale will be continued as long as the selling price of copper is at 17c. or above.

The Empire Zinc Co. operating the Cleveland and Utter mines at Pinos Altos, Grant county, have received a 250-hp. Snow, two-cylinder, four-cycle, crude-oil burning engine which will be installed at the new power-house at the Cleveland mine.

The Santa Fe Gold & Copper Co., operating in the San Pedro district of Santa Fe county, is producing from 8 to 10 tons of copper matte per day, according to reports from that place. The matte is being refined in Omaha. J. E. Bergh is superintendent, and A. Gibson, is smelter superintendent. From 300 to 400 men are now employed at the mines and reduction works.

MEXICO CITY, MEXICO

General Conditions in Southern Mexico: Explosives, Currency, Food, Prices, Mine Taxation, Land Speculators.

The hostilities between Carranza and Zapata have been the chief obstacle to mining since October, 1914. When a mine is visited by a troop of either faction, it means a depletion of explosives, draft animals, and food. A few of such visits are enough to discourage the activity of the most strenuous operator. Even in places where police protection is assured, as in most of the state of Oaxaca, three serious famines have kept the mines closed, as there has been a lack of explosives, of small change, and of food. For over a year there has been no train service from the central dynamite mills in Durango, and the factions have discouraged the private importation of powder for fear it might fall into hostile hands. Explosives can only now be imported by special consular permit, and its date of arrival even then can never be foretold in advance.

When Carranza first arrived in August, 1914, he brought with him a great quantity of paper money which dropped exchange within a month from 30 to 20c. gold, for the peso, but as most of the new paper was in ₱1 bills and there were also plenty of *cartones* (cardboards) for small change, there were no pay-roll difficulties. But in December, after Carranza had moved to Vera Cruz, the printing-presses confined themselves to large bills only, and small bills and *cartones* became so scarce as to command a premium of 5 to 10%. The banks could afford no relief; they had troubles of their own. Forced by Huerta to suspend specie payment on their notes in 1913, they were obliged in 1914 to close many of their branches, to curtail expenses, and to refuse to accept any new accounts. In March, 1915, they refused any longer to accept deposits even from their old clients, and to pay checks in anything but large Federal bills. The banks of issue have been hoarding their own notes for several years, and notes of the National or London banks now command a premium, in Federal bills, of 40%. As it is against the law to ship money by mail, the express companies no longer receive money for transport, and no postal orders or bank-drafts are now issued, one has to carry his wealth when traveling on his person. Mexico has thus reverted in its financial facilities to those of the Aztec confederation.

The food famine is the most serious of all. In spite of the scarcity of farm hands and the destruction of green grain, to make fodder for cavalry horses, there would probably have been no famine except for exportation. Not only have the military chiefs collected large export-taxes in gold upon all material sent away, but they have themselves seized and exported food by the shipload in order to satisfy their insatiable hunger for guns and cartridges. Another result of this suicidal policy, of starving their own people, was a plentiful supply of recruits, but no financial surplus, as all applicants, even boys of 14, were gleefully enrolled and guaranteed wages of ₱1.75 per day. The present misery of the civilian masses who have had no chance to share in the 'blessings' of the Revolutionary militarism may be judged from a comparison of prices, quotations being given in Mexican money:

	October, 1914.	July, 1915.	Increase, %
Maize, per litre	₱0.07	₱0.50	614
Beans, per litre	0.07	0.50	614
Peas, per litre	0.07	0.50	614
Flour, per kg	0.20	1.00	400
Rice, per kg	0.35	1.75	400
Sugar, per kg	0.20	0.80	300
Coffee, per kg	0.80	2.00	150

Even at these prices, maize, the Mexican staff of life, can only be obtained in uncertain quantities. Most mine operators have given up the struggle, and their workmen have either taken refuge in the army or on some plantation, where they can be paid with home-grown food. Thus the difficulties of both the pay-roll and the food-market are avoided.

Of course, with the peso at 8c. gold, the equipment of new mines with machinery becomes impossible for companies whose treasury cash is in pesos. But in mining centres already fully equipped, like Pachuca, the fall in exchange has been a godsend, particularly to struggling companies like the San Rafael y Anexas, as it has meant that the chief item in the cost of production, native labor, has been reduced to a bagatelle. The native miners at Pachuca have managed to struggle along, so far, on little more than the old wage-scale. The American officials have been given half their salaries on a gold basis, and when they change their gold for Mexican paper they feel like millionaires.

Carranza's new schedule for mineral-land taxation, which has been condemned by so many American miners, is really a step in the right direction. The former annual tax of ₱6 per hectare (1 hectare = 2½ acres) for the first 25 hectares, and ₱3 per hectare for any excess area, was entirely too low to hinder speculators, and in 1910 the industry was beginning to feel the throttling effect of having all the likely ground in every district being held by a few dogs-in-the-manger who did no work themselves, but charged others dearly for that privilege. The real burden of the new tax-scale does not consist in its high rates (they only range from ₱12 to ₱24 per hectare), but in the requirement of their payment in gold. With the peso at 8c. gold, the ₱24 rate means ₱150 in paper, and for any miner whose cash has been in Mexico since 1913, and has consequently depreciated in value along with the peso, the new scale means a real advance from ₱3 to ₱150, or 5000%, and probably the speedy loss of his holdings. The new rates are specially unfair to those who are prevented by revolutionary conditions from operating their properties.

The mine-owners of Oaxaca refused to pay taxes under the new schedule, and as the state seceded from Carranza's rule in April, they have not yet had to do so. However, the state certainly needs some higher taxation, as mineral-land specula-

tion has been rampant there for the past decade, and Americans are the chief offenders. In the Magdalena lead-gold district, the Villa Alta, Tatolopana, and Taviche silver districts, the San Fernando lead district, and the great Zaniza iron belt, the likely ground is all occupied by a few individuals or companies who do little besides hold on strenuously to their paper titles to undeveloped ground.

JOPLIN, MISSOURI

High Zinc-Blende Prices Continue.—Lack of Mill Capacity.—Important Development by the Picher Lead Co.—New Work at Neck City.—Tuberculosis.

Abnormally high prices for zinc-blende continue throughout the Missouri-Kansas-Oklahoma district, the basis range being from $80 to $110 per ton for concentrate assaying 60% metallic zinc, at the close of July. At these prices operations can be conducted profitably in many old mines that could not be worked successfully at lower figures. Efforts of operators are largely devoted to getting their mines on a productive basis as soon as possible. There is an unusual amount of drill prospecting underway. Prospects now being opened with drills and new shafts cannot reach a productive stage for some months to come, but so firm is the faith of mining men in a continuation of high prices that they are opening new properties in the hope that when they become producers ore will still be in strong demand. New companies find it impossible to procure old mills, as every plant in the district is in use. Those that were on abandoned leases have been removed to more profitable areas, and so strong has been the demand for treatment plants that not only have old properties become producers again, but machinery dealers have been taxed to meet the demand for new equipment. Especially strong has been the demand for plant for small prospects, hundreds of which are being opened in every part of the district. Upright boilers of about 40-hp. capacity have been at a premium for the past two months, and carload lots of this size have been sold in advance, and purchasers are anxiously awaiting their arrival.

In the north Miami, Oklahoma, district the Picher Lead Co., which for the first time has started mining, has five large shafts into ore at a depth of 260 to 275 ft. Work has been started on four additional shafts. The scene of this activity is eight miles north and slightly east of Miami, or about four miles northeast of Commerce, which is the main centre of the north Oklahoma district. Still north of Commerce is the little town of Cardin, which is developing into a fair-sized mining community. North and east of Cardin is Picher, Oklahoma, which is just cutting its first teeth as a mining community. The first hotel, the initial barber-shop, the pioneer grocery-store and the original pool-hall of Picher have just been ushered into existence, while close by the new derricks of the shafts that already have been sunk loom bright against the background of the gray prairie, and still newer lumber marks the places where other derricks will be constructed. Machinery for the first big plants of this company has been ordered and some of it has arrived at Baxter, Kansas, the nearest railroad point to Picher, from whence it will be carried overland. Bad roads, caused by continuous rains, have prevented the hauling of the machinery at an earlier date.

In the Neck City, Missouri, district one large new concentrating-plant, the Black Hawk, has just been completed and is producing concentrate from the tailing of an old mine that was operated on this land. The Black Hawk is under the management of G. L. Cole. It is situated on a lease of the Calumet Lead & Zinc Co. The mill has a capacity of 300 tons. Mining operations will be conducted at a depth of 200 ft. Pumps are now at work draining the ground.——Another mine in the Neck City district that is attracting interest is that of the Longacre-Chapman Co., where operations have been resumed following the catastrophe that killed four men, in addition to holding four others imprisoned for several days. The catastrophe was caused by a flood that filled the drifts with mud and water. After the work of rescue had been finished and the last dead body removed, a new prospecting company was formed, comprising several of those who had been imprisoned in the mine, and work is now being conducted at the same spot where the four met their death. A rich orebody is being worked at this place.——V. Long & Co. are operating the old Annalinda mine. A new hopper is being constructed at this plant.——At the old Rubber Neck a shallow lead mine is being opened by Compton Brothers.

How flint-dust in the lungs causes tuberculosis was explained at a recent meeting of the Southwest Missouri Mine Safety and Sanitation Association by A. J. Lanza, past assistant surgeon of the U. S. Public Health Service. His address was illustrated by X-ray plates. The Association is devoting its efforts toward making working conditions in the mines of this district more healthful.

The United States Smelting Co., of Boston, is procuring desirable mining leases throughout the district. On a lease just procured at Reeds, Missouri, a 300-ton concentrating plant is being erected. This company acquired control of smelters at La Harpe, Iola, and Altoona, Kansas.

Another cave-in of ground occurred near Joplin last week, several miners being injured. It is to be hoped that rapid ore extraction is not responsible.

CRIPPLE CREEK, COLORADO

Ajax Mill to Resume.—Vindicator and Golden Cycle.—Strong Mine.—Drainage.—Tenderfoot Hill.—Independence.

It is reported that the Ajax mill will soon resume operations. The mill has been idle for some time because of insufficient ore to make operations profitable. Since the mine was recently thrown open to lessees on the split-check system, there is enough ore to warrant re-starting the plant.

On July 26 the Vindicator company distributed $45,000, the regular quarterly dividend of 3c. per share. Net earnings in the second quarter of the year were about $400,000. Surplus profits are being used to pay the Golden Cycle purchase notes, $490,000 out of $1,250,000 having been paid. The cash balance is maintained at over $200,000. Good ore has been opened on No. 18 level of the Golden Cycle. In reaching this a new shoot was opened for over 180 ft., assaying $30 to $40 per ton. Two new shoots have been opened on No. 17. The shaft is being sunk to 1900 feet.

The Strong Gold Mining Co. has completed sinking its shaft to 1350 ft. Below this there is a sump 28 ft. deep. A station will soon be cut on No. 13 level, and immediately after development will be started.

An increase in the flow of water from the portal of the drainage-tunnel was noted last week. The breast of the tunnel has apparently pierced the rib of tight ground immediately adjacent to the Elkton mine and the broken volcanic area. From now on the water should rapidly recede from the shafts at all affected by this tunnel. Favorable results from the lowering of the water-level are already materializing. The Elkton shaft will be sunk again in the near future. The Portland company expects to start sinking its No. 1 shaft soon after August 1.

In the region of Tenderfoot hill, the new deposit at the Ella W. continues to produce a large tonnage of medium-grade ore. Prospecting in that vicinity has greatly increased during the last few weeks. While several developments have been reported nothing persistent has been uncovered.

There are about 25 sets of lessees at work on the Independence mine. A number of these are breaking a good grade of ore. Others are doing development work. Several of the latter have excellent prospects of opening up new orebodies within a short time.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Final figures of the territory for 1914 are as follows, according to the U. S. Geological Survey: gold, $15,764,259, an increase of $140,000; copper, 21,450,628 lb., a decrease of 209,330 lb.; total value of metals, $19,118,080, against $19,476,356 in 1913. Total to date, $268,150,000, of which gold accounts for $244,156,000.

The Governor of the Territory, J. F. A. Strong, returned to Juneau last week after a month's tour including Fairbanks and Nome. He summarized his impressions as follows: "I found the general conditions all through Alaska excellent. There is a spirit of hopefulness abroad that is characteristic of Alaska, and none of the depression we read about below. There is a good deal of unemployment, it is true, but there is no place in the country that I know of where a man always has a real chance to get a living as he has in Alaska. As we went down the Yukon I was particularly impressed by the improvement in the towns along the river. It looked as if every town on the river had a cleaning-up week. The buildings have been re-painted in many cases, and the streets have been cleaned up. The old reckless camp spirit seems to have mellowed into an admirable brand of civic pride."

The territorial mine inspector, W. Maloney, arrived at Nome on July 10. He recently visited nearly every district in the country outside of Seward Peninsula, and found conditions flourishing, particularly at Ruby and Iditarod.

Juneau

Hot weather has resulted in making the woods dry, streams low, and numerous fires starting on the mainland and on Douglas Island.

In the suit of V. Vansteen against the Alaska Gastineau company for $50,000, damages for injuries received in driving the Sheep Creek adit on July 15, 1913, Judge Jennings decided in favor of the defendant. If the accident had occurred 15 days later the case would have come under another statute. The 'fellow-servant' law was abolished by the first Legislature in 1913.

The Ready Bullion shaft is to be deepened from 2200 to 2400 ft. on the incline.

A great deal of work is being accomplished at the Alaska Gastineau property to prepare it for a large output of ore, ultimately 10,000 tons per day. During this period it is necessary to break about $2^1/_2$ times as much ore as is milled at present, about 3000 tons per day. This has a tendency to lower the average gold-content. The estimated cost of mining, 75c. per ton, has been lowered. The mill treated the following tonnage: March, 40,000; April, 57,000; May, 73,500; and June, 90,800. The cost of treatment is only 60% of what it was at the beginning. Construction of the other units of the plant continues. The Sheep Creek dam overflowed on June 18.

On July 24 work commenced driving a 1300-ft. tunnel to tap Annex lake 150 ft. below the surface of the lake. This will save the expense of making a dam, as the lake is fed by about 20 streams. From the mouth of the tunnel an 8000-ft. pipe will carry water to the Gastineau company's power-plant.

The Alaska Treadwell output in June was affected by an accident; it was as follows: ore crushed, 51,006 tons; gold by amalgamation, $75,786; gold from cyanidation, 1217 tons of concentrate, $62,099; total value, $137,885; operating expenses, $73,004; construction charges, $25,610; net profit, $37,892. The average yield was $2.70 per ton. Development totaled 326 ft. The stock of broken ore decreased 32,178 tons.

ARIZONA

The Southwestern Mine Safety Association will hold its annual field meet at Bisbee on September 6 and 7. If $1600 can be raised it is intended to send the winners of the state contest to the meet at San Francisco on the 23rd and 24th. Seven mining companies have agreed to donate $200 to the fund. No. 2 rescue-car of the U. S. Bureau of Mines will be at Bisbee during the contest. All works at the mines will be suspended on the day of the field meet. Wallace McKeehan is secretary-treasurer.

Cochise County

Pay-days on July 20 and 21 were the largest in the history of the Warren district. The three large companies are operating at high pressure.

At Tombstone, the Bunker Hill company is treating 60 tons of $7 ore per day. Old tailing is also being treated. Pumps are working at the shaft where a large sum was spent on drainage years ago. About 300 men are employed in charge of E. Grebe.

Gila County

On about August 1 churn-drilling was to be started at the A. S. & R. Co.'s property at Christmas, recently acquired from the London-Arizona company. An aerial tram will carry ore to the Hayden smelter.

Mohave County

It is reported that within a year the old McCracken silver mine, 40 miles south of Yucca station, will be treating 500 tons of ore per day. A mill of that capacity is being planned. The mine is estimated to contain ore worth $700,000, the average being 16 oz. per ton. C. E. Finney of Los Angeles is largely interested.

Pima County

Eleven contractors bid for construction of the Calumet & Arizona company's 44-mile railway from Gila Bend to its copper mines at Cornelia. The successful one was James H. Maxey of Yuma. The line is to be completed by January 10, 1916.

CALIFORNIA

Eldorado County

A 10-stamp mill is to be erected at the Frog Pond mine in the Garden Valley district. C. Waite and T. J. Dayley are largely interested.——The Ward and Union gravel mines near Placerville have been bonded to J. Wilmans.

Inyo County

Mining activity in the eastern part of this county may be summarized as follows: Zabriskie, on the Tonopah and Tidewater line, is a busy distributing centre for about 15 mines. The two largest are the McCausland and Carbonate. The former gold mine is at an altitude of 3500 ft. in the Funeral range; the mill is 135 ft. below sea-level. Other mines in the district are the Acacia, Confidence, American, Rusty Pick, Ibex, Wonder, Rob Roy, and Gladstone. Copper and talc deposits are receiving attention.

Placer County

At the old Herman mine, five miles from Westville, 20 men are working. Three veins occur in the mine, and 4367 ft. of development has been done. By the end of the year it is expected that the 30-stamp mill will be in operation.——With its small stamp-mill and a Marks centrifugal mill, the Excelsior mine near Forest hill will soon be producing 150 tons

of ore daily. The present 25 men are to be increased to 50.—— After being idle for many years the Big Oak and Rising Sun mines near Colfax may be re-opened.

San Benito County

Near Hollister, L. H. Day and H. U. Underwood are preparing to develop a large deposit of high-grade barium sulphate.

Shasta County

On July 31 at Gas Point the Shasta Dredging Co. received by wagon from the railway at Cottonwood, 14 miles, a screen for its new boat. It is 6-ft. diameter, 31 ft. long, and weighs 18.5 tons. This is the largest piece of machinery ever hauled in the county. Twelve horses were required.

The Ora Vista dredge of L. Gardella at Oroville, Butte county, is to be dismantled and moved to his Clear Creek property, four miles south of Redding.

The Golinsky copper claims, two miles west of Kennett, have been bonded to the Mammoth Copper Co. A good deal of ore has been sent to Utah from them.

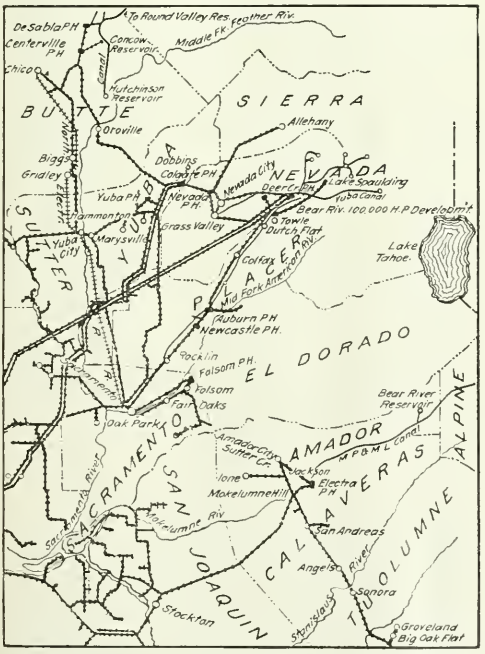
Sierra County

In the erection of the new 15-stamp mill at the Plumbago mine by R. Hathaway, the contractor, the material was hauled 28 miles from Nevada City. Work commenced on June 1; on the 26th the plant started work.

Tuolumne County

The Golden Key mine near Sonora is to be re-worked on an extensive scale in charge of F. A. Wallin. The ore is opened by adits.

The annual report of the Pacific Gas & Electric Co., for the year ended December 31, 1914, has just been issued. Of its



MAP SHOWING POWER-LINES OF PACIFIC GAS & ELECTRIC CO. SUPPLYING MINING AND DREDGING DISTRICTS.

revenue of $8,759,449 from the sale of electricity, power sold to mining and dredging companies yielded $591,314, an increase of $33,852. Sales of water for power were $58,909, but the amount credited to mining is not stated.

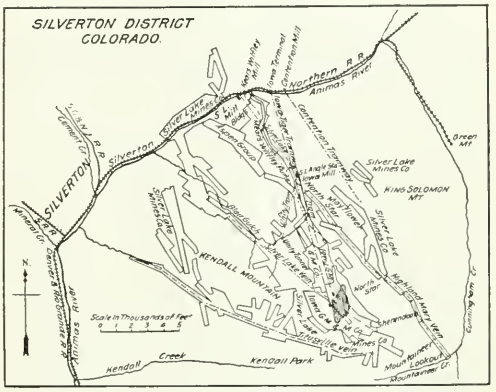
COLORADO

Clear Creek County

Leases at the Waldorf mine at Georgetown are employing about 40 men. A large tonnage of ore is being extracted.

San Juan County

In the *Silverton Weekly Miner* of July 16 the Silver Lake property is described. It has been a consistent producer for 20 years. There are about 200 claims in all, covering 1500 acres, at an altitude of 12,300 ft. From approximately 18



miles of underground workings the output is $11,000,000. The Silver Lake and Titusville lodes are probably the most persistent, but the ore is generally low-grade. The former vein contains lead, silver, and zinc; the latter, copper, lead, zinc, and gold. Many of the district veins junction with the Silver Lake. Work at present is mostly confined to the Titusville claims. The mill consists of two units, one of 300-ton capacity for the Silver Lake-Titusville and the one of 150 tons for ore from the Aspen mine. The property is worked by several different lessees. The Americau Ore Flotation Co. has a lease of the mill. A flotation plant is working successfully. Concentrate is sent to the Durango smelter. D. L. Thomas is in charge of the plant, with P. M. Collins as foreman. Mears and Wilfley are treating tailing from the old mill at a new plant.

Lake County (Leadville)

Iowa gulch is fairly active after several years of dullness. Lessees at the Lillian are shipping gold and zinc carbonate ore; about 250 tons in July. The Clear Grit is to resume. Doris and others are receiving attention.——Lessees in the Laplander adit have finished the difficult work of driving the 200-ft. cross-cut from the main adit to a winze which produced rich silver ore years ago.

Pitkin County

At Aspen the Doctor Leasing Co. has arranged a contract worth $100,000 for marketing the large tonnage of zinc ore in the Doctor mine. By November 1, 5000 tons of not less than 30% ore must be delivered. G. Runtz is in charge.

IDAHO

The itinerary of Bureau of Mines rescue-car No. 5, in charge of John Boardman, is as follows:

Mullan, was at the Gold Hunter mine, July 26 to 31; Mullan, at Morning mine, August 1 to 7; Burke, 8 to 14; Mace, 15 to 21; Success, 22 to 28; Kellogg, August 29 to September 11; Wallace, 12 to 15; and Spokane, Washington, (shops for repairs) September 16 to October 9.

Blaine County

During July the Wilbert mine, in the Dome district, shipped 16 cars of ore to Utah, netting $34,502 at the smelter. The freight was $3187.

Clearwater County

To meet the increased parcel-post rates on ore after September 1, miners will send by parcel post to Stites, on a branch of the Northern Pacific line, and thence to smelters by rail. It was found that the new charges would result in closing down some mines.

Lemhi County

During July the Pittsburg-Idaho mine, near Gilmore, shipped 32 cars of ore to Utah, worth $40,922. A new shoot is being developed between 400 and 600 ft. Lessees are doing well.

Shoshone County

It is reported that the Interstate-Callahan company offered $450,000 cash, and another larger sum, for the Ray-Jefferson property. The offers were not accepted.——It is also rumored that the Hercules company and A. S. & R. Co. have compromised on the smelting contract dispute.

On August 4, the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 215, of $81,750. This makes a total of $16,364,250.——The Caledonia company will pay 3c. per share, or $78,150, during August. A car of lead-silver ore, weighing 35 tons, recently netted $6500, the richest lot ever sent from the Coeur d'Alene. A winze below the 900-ft. level has opened 8 ft. of ore, some of which assayed 180 oz. silver per ton.——The Snowstorm Mining Co. will surrender its option to buy 650,000 shares in the Missoula Copper Co. to the National Copper Co. for $27,000, the last named to continue payments on the shares to the Missoula. The National mill at Mullan will treat ore from the Missoula.

In the Mullan district are three copper mines which promise well in the future, namely, the Carney, Reindeer-Queen, and Carbonate Hill. Long adits have been driven into them, with good ore showing. A mill is contemplated for the last mentioned, in charge of A. Haden.——Fourteen miles east of Mullan the Richmond company is shipping copper ore. The property is well developed and equipped. C. Heidenreich is manager.

MICHIGAN

The Copper Country

The Isle Royale mine is now producing about 2400 tons of ore daily. Half of this goes to its own mill. The average copper-content is about 13 lb. per ton.——The Calumet & Hecla has resumed all construction work stopped last August.

The Calumet & Hecla's smelter at Hubbell has 22 furnaces in blast. The re-grinding plants have resumed, a temporary power-supply being secured from the Ahmeek turbo-generator. ——A large number of men are busy making foundations for the leaching plant.——Work at the Tamarack re-grinding plant has been suspended.——The Copper Range Consolidated is receiving bids for fifty 50-ton new steel ore-cars. They are of a new type, constructed from the design of M. N. Barker to carry ore or stamp sand. The sand is used for filling underground.——The Osceola is producing nearly 5000 tons of ore per day.——At the 'little' Tamarack mill two stamps are to be added.——The third new head at the Isle Royale will be ready in a week.

The Michigan College of Mines has issued its year book for 1914-1915, with announcement of courses for 1915-1916. It consists of 116 pages, tables, and three good maps.

MISSOURI

Jasper County

Production of the Missouri-Kansas-Oklahoma district last week was as follows: blende, 4883 tons; calamine, 207 tons; and lead, 521 tons. The average price was $99.93, $60.89, and $59.96 per ton respectively. The total value was $532,083. Choice concentrate realized $115 per ton. Good calamine is in strong demand. Lead ore remains unchanged.

The Castle Rock district, northeast of Joplin, once a centre of small mines, is receiving renewed attention. Zinc ore is cut at from 60 ft. downward.

MONTANA

Missoula County

The Intermountain Copper Mining Co. is to acquire the property of the Amador Mining Co. near Iron Mountain. A two-mile flume has been repaired, foundations for a 100-ton mill are completed, and the lower workings of the mine are to be drained and re-timbered. The shaft is 700 ft. deep. Oscar Nordquist, of Wallace, Idaho, is in charge.

Silverbow County

The report of the North Butte company for the second quarter of 1915 contains the following: ore and precipitate treated, 86,978 tons; copper yield, 4,490,324 lb.; silver, 239,513 oz.; and gold, 270 oz. Development totaled 2920 ft. The new electric plant at the Granite Monntain shaft is hoisting everything, the Speculator shaft being idle. The Edith May vein was driven on at 2200, 2600, 2800, and 3000 ft. Work at the last level proved the continuity of the ore from 2800 ft. Results on the Snowball vein were satisfactory. The property is working at 90% capacity.

The Butte-Alex Scott company is installing a Nordberg hoist of 3000-ft. capacity. The daily production is from 150 to 175 tons of high-grade ore.—The Butte-Ballaklava is shiping about 250 tons per day. At 1600 ft. ore has been opened for 320 ft.——The Anaconda company has started suit against the Butte Copper Co. for a partition or sale of the Robert Emmett No. 1 and 2 claims. The plaintiff owns 66⅔, and the defendant the remainder. F. A. Heinze once controlled the property.

NEVADA

Elko County

Ten miles northwest of Tuscarora an important discovery of gold-silver ore is reported. The nearest railroad point is Elko.

Esmeralda County

The estimated production of the Goldfield Consolidated in July is as follows: Ore mined, 33,388 tons; gross extraction, $275,000; operating expenses, $170,000; and net realization, $105,000.

On September 1 the Jumbo Extension will distribute 7½c. per share, equal to $116,250.

Humboldt County

According to the *Review-Miner* of Lovelock, from within a radius of 30 miles of the town, three cars of antimony ore has been shipped, realizing $5500.

Nye County

Seven mines at Tonopah last week produced 10,407 tons of ore worth $213,286.——Better ore is being opened at 1350 ft. in the Extension.——Lessees at the Montana shipped 107 tons of $31.60 ore to the West End mill last week.——At 1155 ft. the Mizpah Extension is driving on 3 ft. of ore.——At the East End sinking has been resumed.

TEXAS

Brewster County

(Special Correspondence.)—T. B. Weir and J. C. Scott, who are reported to be interested in quicksilver mines of California, recently visited the Terlingua quicksilver district in the lower part of this county, close to the Rio Grande. They acquired a large tract of land upon which outcrops of cinnabar are found. They propose to start mining operations as soon as the necessary machinery and other equipment can be installed. A 40-ton furnace will be built when sufficient ore has been opened to justify it. The Terlingua district is reported by engineers who have examined it to be one of the richest. The deposits have been little developed. The fact that the district is 90 to 100 miles from the nearest railroad has handicapped development considerably.

Terlingua, July 18.

UTAH

Juab County

The Tintic district produced 163 cars of ore last week.——Electric pumps are working at 1600 ft. in the Gemini.——Diamond-drilling is still being done at 1900 ft. in the Iron Blossom.——The Bingham Mines Co., which controls the Eagle and Blue Bell has acquired the Victoria mine adjoining the latter.——At the Tintic Standard four jigs are treating 35 tons of ore per day.

CANADA

British Columbia

On September 10 the Standard Silver-Lead company will distribute 2½c. per share, equal to $50,000, after a year's lapse. The total to date is $1,600,000. As regular shipments of lead and zinc ore are being made, monthly payments will be kept-up.

At Grand Forks the Granby company has eight furnaces in blast. About 250 men are employed there, also 600 at the mines at Phoenix. The company has bonded the Gloucester copper claims for about $100,000.

Ontario

(Special Correspondence.)—At the Hollinger the decline in grade is due to the policy of the management of developing all ore that will yield a profit over working costs. Ore is now being extracted from 14 or 15 veins, the smaller being invariably of lower grade than the main vein. It is probable that the grade of the ore treated will be gradually lowered and a larger tonnage from many veins treated. A winze is now down to 950 ft.; good ore is being mined at 800 feet.

Porcupine, July 28.

At the McIntyre, at Porcupine, No. 3 shaft is down 500 ft. A station has been cut there. Sinking continues to 600 ft. At this depth at No. 4 shaft there is from 12 to 20 ft. of ore. Profits in April, May, and June were $23,777, $23,928, and $21,326 from 7870, 8360, and 9180 tons respectively. The company has purchased the Pearl Lake mine for $200,000.——It is rnmored that work may be resumed at the Jupiter.——Development at the Imperial is very satisfactory. At 100 ft., $13 ore is being extracted.

MEXICO

El Oro

A report dated London, July 9, 1915, includes the following remarks on work at the Esperanza mine, El Oro, Mexico, from January 1 to March 31:

On account of revolutionary activities, railway service was discontinued on January 26, since which date no bullion shipments have been made nor supplies brought in. El Oro became the centre of such activities about this time which came to a crisis on February 25, at which time the place was completely abandoned, thus shutting down all mills in the district. Mining operations were also discontinued, but underground prospecting was continued, 1892 ft. of development being done in the Esperanza. Conditions have improved only slightly since the above mentioned date, and no supplies have been obtained. Ten tons of cyanide and other supplies were brought down to Acambaro during the period under review, and remain there safely stored. Only a few important development programs were started again. These are being carried on, for instance, work on the Descubridora vein, and the sinking of winze No. 16 to the 15th level. General repairs in the mine are being kept up; all stopes having been properly filled. Diamond-drilling continues also on a reduced scale, due to the small stock of repairs and stones on hand. The work of re-opening the Sirio shaft continues whenever possible. In the mill some important changes are being carried on with the idea of improving the work of the Merrill slime-presses, and further plant is being installed to improve the cyanidation of San Carlos and Descubridora ores. It should be said that the mail, telegraph, and railway services are cut practically all the time.

PERSONAL

Gerald Sherman is at the Hotel Oakland.

J. Parke Channing was at Butte recently.

Charles M. MacNeill is at the Fairmont hotel.

J. V. N. Dorr is spending a month at Berkeley.

J. W. Foss, of Phoenix, is visiting San Francisco.

W. B. Fisher, from Boston, is in northern California.

W. H. Aldridge has returned to New York from Arizona.

T. Bruce Marriott has returned to London from the Argentine.

James F. Kemp is taking a holiday on Lake George, New York.

F. R. Weekes has moved from New York to Darwin, California.

Edwin E. Chase has returned to Denver from northern Ontario.

Charles E. Arnold is here on a holiday from Miami, Arizona.

W. L. Cumings, of the Bethlehem Steel Co., is sailing for Chile shortly.

Horace V. Winchell has returned to Minneapolis from British Columbia.

F. Sommer Schmidt and Henry Krumb have been to Latouche island, Alaska.

Rensselaer H. Toll, now mining at Carson Hill, Calaveras, visited the Exposition.

E. C. L. Bartow of Philadelphia has been visiting the San Juan region of Colorado.

Charles W. Wright, now at Washington, will return to Sardinia early in September.

Warren D. Smith, professor of geology in the University of Oregon, is here for ten days.

Benjamin Madew has been appointed consulting engineer to A. Goerz & Co., of London and Johannesburg.

F. W. McNair, president of the Michigan College of Mines, was here during the week, after a visit to Butte and Salt Lake City.

Frederick L. Hoffman has been visiting the chief mining centres in connection with his study of hygiene and sanitation in mines.

Schools and Societies

The fifty-first meeting of the American Chemical Society will be held at Seattle, Washington, August 31, to September 3, inclusive. A complimentary dinner by the science faculty of the University of Washington to the members of the Council, followed by a business meeting, will be held on August 30. There will be sessions for reading papers, and excursions are planned.

(Special Correspondence.)—As mentioned in the Press of July 31, the Lake Superior Mining Institute meets at Ironwood on September 6, 7, 8, and 9. The visit to the Cuyuna range will be the first of the society. The district is the last of the six Lake Superior iron ranges to be discovered. A lot of development has been done, but owing to low ore prices little ore has been shipped. The Institute was originally organized as an annual 'getting-together' of officials of the iron mines, but in recent years machinery salesmen and people affiliated with mining have joined. The annual meeting is looked forward to by men both in the copper country and iron ranges. A number of interesting papers are to be read and discussed this year, as well as the excursions and first-aid meet.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, August 5.

Antimony	35 —35¾
Electrolytic copper	20½—20¾
Pig lead	5 50— 6.45
Quicksilver (per flask)	$95
Spelter	23 —23¼
Tin	39
Zinc-dust, 100-kg. zinc-lined cases	No quote

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, August 5.—The copper market is lifeless; the lead market is steadily falling; the spelter market is dull, there being no buyers, and prices are merely nominal.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
July	29 18.37	June	23 20.00
"	30 18.25	"	30 20.00
"	31 18.25	July	7 19.75
Aug.	1 Sunday	"	14 19.50
"	2 18.25	"	21 19.04
"	3 18.25	"	28 18.62
"	4 18.25	Aug.	4 18 27

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports in the week ended July 17 totaled 6,351,262 lb. valued at $1,206,787. Imports were 8,086,319 lb. of all kinds of metal.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
July	29 46.87	June	23 48 97
"	30 47.12	"	30 48.40
"	31 47.12	July	7 48.10
Aug.	1 Sunday	"	14 47.56
"	2 47.12	"	21 47.47
"	3 47.12	"	28 47.39
"	4 47.12	Aug.	4 47.08

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57 58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec.	49.27	....

Silver has been to a record low price. On July 31 a steamer took about 750,000 oz. to China. Over three tons of Mexican dollars arrived at Bisbee, Arizona, on July 30, from China. This metal is probably for Cananea, where wages are paid in this coin. Speculators in New York are reported to be buying silver for a future rise. The Nipissing sent 250,509 oz. to London last week, a total of 511,673 oz in July. The Buffalo sent 263,943 oz. to New York for storage. This company has sold no metal since the War started. Stocks in London are about 20,000,000 oz. Continental support has been limited. Samuel Montagu & Co. on July 15 wrote as follows: "The tone has been without animation, and were it not for the scantiness of supplies, it would have been difficult to maintain prices. The abstinence of the Indian Bazaars has been again a noticeable feature. The market is so small that a little revival of demand from that quarter would cause an immediate rally in prices. In addition to reasons previously given for their lack of interest, may be added a deficiency of rain in certain districts of India. At so early a period there is no need for serious apprehension, but as the monsoon was rather late in arrival, a certain amount of nervousness might arise. China has been more inclined to sell than buy, and the weight of absorbing silver has fallen mainly upon Continental and other buyers apart from the East.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July	7 95.00	July	21 95.00
"	14 95.00	"	28 95.00
		Aug.	4 95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60 00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

It is interesting to note that certain Eastern metal journals are now quoting about the same price for quicksilver as the PRESS. Some time ago the difference was considerable, but the situation is better understood now.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July	29 5.40	June	23 5.82
"	30 5.40	"	30 5.55
"	31 5.20	July	7 5.75
Aug.	1 Sunday	"	14 5.71
"	2 5.00	"	21 5.58
"	3 5.00	"	28 5.50
"	4 4.75	Aug.	4 5.12

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

A large dividend is predicted to be paid by the St. Joseph Lead Co., Missouri. The company is now exporting large quantities of metal, for the first time, its business having been entirely domestic.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
July	29 18.12	June	23 18.71
"	30 18.12	"	30 20 58
"	31 18.00	July	7 22.10
Aug.	1 Sunday	"	14 22.26
"	2 17.75	"	21 20.33
"	3 17.50	"	28 18.96
"	4 17.25	Aug.	4 17.79

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On August 4 tin was quoted at 35.12 to 35.67 cents.

ANTIMONY

This metal affords some contrast to the others. It is fairly active, with prices easy at 35.25 to 36 25c. for both Chinese and Japanese. This firmness is noticeable, when the weakness in other metals is taken into consideration, especially as antimony has advanced more than any other since the War began.

Eastern Metal Market

New York, July 30.

There is practically no change in the metal-market situation since last week except that prices have declined. The threatened strike at the plant of the Remington company at Bridgeport failed to materialize; this is also true of the threatened general strike of the machinists. While the labor leaders report gains in the ranks of the unions, none of the plants in the vicinity of New York making munitions are having trouble. It is reported that the men are growing restless, but so far it is more or less of a waiting game. Two of the New Jersey plants have granted a 10% wage increase; others are rumored to be about to follow. At Boston one plant has closed down following the walk-out of a number of men; at another, controlled by the same interests, the workmen, while arguing for shorter hours and more pay, have taken no decisive action. In the meantime the large Bliss plant, which was reported as one that would be closed down, is still working both day and night.

Orders for war material requiring brass, lead, and other non-ferrous metals are still being placed in this country. A $3,000,000 contract for brass-shell cases for the Italian government has been placed with a Chicago company. This order calls for 1,250,000 shrapnel shell-cases, and is in addition to one for 500,000 brass-shell cases received from the Russian government about two months ago. A contract for small shells, rifles, and rifle-cartridges is reported as being practically secured by a Pittsburg manufacturer of bolts, nuts, rivets, and lightning-conduit from the Russian government. The value of this contract, which is the second largest received from that country, is $68,000,000. It is expected that most of the work will be sublet, as was the case with the $3,000,000-shrapnel contract received early in the year from the same source. The bullets called for will, in all probability, be made at the Remington plant.

In iron and steel lines the market developments of the week include an order for 220,000 tons of bars for shrapnel for the French government, and there are inquiries for 100,000 of bars for war munitions for domestic and foreign plants before the trade. It is estimated that 20 to 25% of the current output of the leading steel companies is represented in war materials. Pig iron has become firmer as a result of higher levels being established in the steel lines.

COPPER

As was reported last week, prices, although nominal for the most part, have a sagging tendency. There is no new business of any great amount and buying is very small. On the other hand, consumption continues on a large scale. Most of this is for war orders, and a further inquiry for 50,000 tons is reported. Little credence is, however, given to the report. The domestic demand is somewhat limited and prices are therefore nominal. Large quantities of copper must still be bought to fill munition contracts, but these buyers apparently are cautious in making purchases and are proceeding slowly. When this buying movement is started there will, of course, be a rally, but until then the market is quite likely to remain quiet. Prices have declined from 19c., cash, New York, for electrolytic on July 21 to 18.50c. Second-hands are offering the metal as low as 18c., although it is hard to hold the market steady. Large producers, however, predict a return to the 19c. level in the not far distant future, and are not offering the metal under that figure. Lake copper has been steady at 22c. for high-grade brands, although some have been quoted as low as 19c. The exports July 1 to 29 amounted to 14,588 tons.

The increase in the production of copper by four large properties in April, May, and June is shown clearly in the following table, compared with the yields (in pounds) in those months of 1913 and 1914:

	1915.	1914.	1913.
Utah			
April	12,015,148	13,133,779	9,834,894
May	14,053,765	13,616,993	10,312,695
June	14,730,912	13,268,106	11,637,949
Nevada Consolidated			
April	4,710,684	4,880,043	5,650,608
May	5,271,756	4,959,589	5,933,275
June	5,124,480	4,483,175	6,344,863
Ray Consolidated			
April	5,333,387	6,277,693	4,514,565
May	5,107,717	6,495,719	4,495,217
June	4,341,127	6,226,536	4,392,612
Chino			
April	3,027,548	6,109,888	4,046,813
May	6,442,977	5,666,881	4,067,486
June	6,984,977	5,656,102	3,876,533

ZINC

The prices for this metal are still on the down grade, due to increased production coupled with poor demand. While definite figures are lacking, it is known that the production has increased, the rate at the present time being, it is said, 100,000 tons greater per year than on January 1. The substitution of black and other sheets for the galvanized product has also exerted its influence to depress the market. Between the small size of the domestic inquiries and the absence of any foreign business, which the producers anticipated would sustain the market, there is nothing of great interest in this market. During the past week the price has declined 1.50c. It is still almost impossible to secure the special brass-mill grades at 30c. Exports from July 1 to 29, inclusive, total only 4241 tons, a very low figure compared with any other month since September 1914.

LEAD

The easy tone last week again prevails, and there is no noticeable improvement. The market is ruled almost entirely by re-sale lots due to the heavy deliveries by the leading interest on old contracts. The absorption of these lots is difficult, as the demand is light. The price of re-sale lots has declined to 5.50c., New York, and 5.40c., St. Louis, but producers are confident that the market will not go much lower. They base this belief on the ground that consumers must soon enter the market. It remains to be seen, however, how much foundation there is for this feeling, meanwhile dealers are offering some of the leading brands at the low prices. The exports for the month, including July 29, have been 2203 tons.

TIN

What has been said about the other metals applies with equal force to tin. The market is very dull and weak, and there have been no manifestations of activity for the past week. All the business that has been done, and that is but little, is in spot metal. Buyers, who look for still further declines in prices, do not show much interest in the market, although some attractive offers have been made in future shipments from the Straits. That the large independent consumers or tin-plate makers have covered for their requirements for the entire year is a feeling that continues to gain ground. This would seem to indicate that the business done in the latter portion of May and through June was greater in volume than was believed at the time.

MINING DECISIONS

Severance of Minerals by Map Dedication

A reservation of mineral rights in a dedicatory map of a townsite subdivision will not avail the dedicator or its successors in interest as against lot owners under a deed containing no reservation of such mineral rights. The whole title to the land passed by the deed in general form, even though the grantor may have made a prior dedicatory severance.

Hyde Park Investment Co. *v.* Glenwood Coal Co. (Iowa), 153 Northwestern, 180.

Conveyance of Minerals—Creates Taxable Interest

An instrument "granted, bargained, sold, and conveyed" to the grantee all the oil, gas, coal, and minerals under a certain tract on land in consideration of the payment of stipulated royalties and compliance with certain conditions by the grantee. Held, that this constituted a conveyance of an interest in the realty which was subject to taxation in the lands of the grantee, and not a mere usufructuary right or privilege taxable against the grantor as a part of the land.

Texas Company *v.* Dougherty (Texas), 176 Southwestern, 716. May 21, 1915.

Mining Contract—Fraudulent Representations

A prospective purchaser engaged an expert miner to examine a mine for him and relying on his favorable report, purchased it. It appears that the sellers washed the dirt away from the ore, thus giving it an appearance of an untrue proportion of pure ore, and represented that the mine would yield an exaggerated percentage of pure ore. It did not appear that the miner who examined the property for the purchaser was deceived by the representations or had appraised the property as more than a 'possible mine.' Held, that the purchaser, after trying to operate the mine and finding it a failure, could not recover purchase installments already paid upon abandoning his contract, as there was no showing of any fraudulent inducement which was relied upon by him on making the purchase.

Greenstreet *v.* Walsch (Missouri), 176 Southwestern, 1062. May 24, 1915.

Location Notice—Amendment Cures Defects

Certain ground was located as the Lafayette claim in 1901, but was forfeited and abandoned in 1902. In January 1903 it was re-located as the Eagle No. 2 claim, but the location notice failed to state that it had been located as abandoned or forfeited ground, a requirement prescribed by Section 3241, Civil Code of Arizona (1901). In 1907 the land was again located by adverse parties as the Oversight claim. In 1912, the Eagle No. 2 locators posted and recorded an amended location notice setting forth the statement omitted from their original location to the effect that they were locating forfeited or abandoned ground. They then applied for patent and the Oversight locators adversed and brought suit. Held, that as the Oversight locators were strangers to the original Lafayette title, they could not claim protection under the Arizona Civil Code section above cited, which was intended to provide notice to claim-owners of re-locations made on their claims under claim of forfeiture. Moreover the amendment of the Eagle No. 2 notice in 1912 related back to the original location and cured the defect if any existed. The Oversight claimants, although they were intervening locators were not affected in any of their rights by this amendment. Judgment for the Eagle No. 2 locators.

Copper Queen Consolidated Mining Co. *v.* Stratton (Arizona), 149 Pacific, 389. June 12, 1915.

RECENT PUBLICATIONS

Latin American Monetary Systems and Exchange Conditions. By Joseph T. Cosby, manager foreign department of the National City Bank of New York. P. 31. An abstract of this will appear in another issue of the Press.

District of Ungava. Extracts from reports on this territory recently added to the Province of Quebec, under the name of the Territory of New Quebec. P. 208. Ill., map, index. Mines Department, Ottawa, Canada, 1915. The area is 351,780 sq. miles, added to Quebec's 351,873 sq. miles. Gold, silver, copper, iron, and other minerals occur.

Map of Helena Mining District, Montana. 42 by 62 in. Also index to map, 32 pages. The Engineering Corporation, Helena, 1915. A note on this was published in the Press of July 24.

Mineral Resources of New Mexico. By Fayette A. Jones. Bulletin I. P. 77. Map and catalogue of minerals. State School of Mines, Socorro, New Mexico. This was reviewed in the Press of July 24.

U. S. Bureau of Mines, Washington, D. C., 1915:

Methods of Preventing and Limiting Explosives in Coal Mines. By George S. Rice and L. M. Jones. Technical Paper 84. P. 45. Ill., plans.

Permissible Explosives. Tested prior to March 1, 1915. By Spencer P. Howell. Technical Paper 100. P. 15.

Estadistica Minera en 1913. Por Carlos P. Jiminez. Boletin del Cuerpo de Ingenieros de Minas del Peru. No. 81. P. 132. Lima, Peru, 1915. The mineral output of this republic in 1913 was valued at Lp. 4,494,806 (about $22,000,000), against Lp. 4,627,963 in 1912. Copper, silver, and oil accounted for about Lp. 3,900,000.

Building Stones of Ohio. By J. A. Bownocker. Bulletin 18. P. 160. Ill., index. Geological Survey of Ohio, Columbus, 1915.

Mineral Production of Pennsylvania, 1911. Parts A, B, C, D, and E. P. 84. Report No. 8. Topographic and Geologic Survey of Pennsylvania. Harrisburg.

Limestone Road Materials of Wisconsin. By W. O. Hotchkiss and Edward Steidtmann. Bulletin XXXIV, Economic Series 16. P. 137. Ill., chart. Wisconsin Geological and Natural History Survey. Madison, 1914.

The Little Buffalo Basin Oil and Gas Field, and the Grass Creek Oil and Gas Field. By F. F. Hintze, Jr. Bulletin 11. P. 120. Ill., maps. The state of Wyoming geologists (L. W. Trumbull) office, Cheyenne, 1915.

Les Minerais de Fer de la Province de Quebec. Gisements et utilisation. Par P. E. Dulieux. P. 243. Ill., plans, index Service des Mines, Quebec, 1915.

Report of the Royal Commission on the mining industry at Broken Hill, New South Wales. P. 862. Government printer, Sydney, 1914. Price £1, or $4.80. This is a voluminous report containing besides much data on sociological conditions in this lead-silver-zinc district, 24,381 questions and answers covering every phase of mining contracts, ventilation, drilling, hoists, wages, stoping, and labor disputes, occupying considerable space.

EDITORIAL

T. A. RICKARD - Editor

THE TRUE interest of the American people lies in the restoration of peace.

ALASKA, which was bought from Russia for $7,200,000 in 1867, has produced $244,156,000 in gold since the date of the transfer to the United States.

MEXICAN affairs are making progress. The administration at Washington seems fully awake to the importance of bringing the present impasse to an end. In our next issue we hope to be able to comment on real progress toward a settlement.

DEPRESSION in the silver market is causing the mines at Cobalt to store their output of metal and to restrict their production of ore, in the hope that the end of the War will cause a rise in price. This is dangerous, for it is not so much the War as the by-production of silver in the extraction of copper that is exerting a depressing influence.

TANGANYIKA CONCESSIONS is gaining respect as a copper producer. In 1914 the output was 92,381 tons of ore yielding 10,722 tons of copper, while working two furnaces on average. For the first half of 1915 the output was 6932 tons of copper, working three furnaces. Next year two more furnaces, increasing the existing capacity by 30 to 35%, will be available, so that an output of 25,000 tons of copper is promised.

A GOOD example of the falsity of much of the industrial data connected with the War are the two opposite reports, first that the people of Germany are selling their copper utensils to the Government at the full value, not of the metal but of the articles; second, that the German supply of copper exceeds 2,000,000 tons, that is, more than double the domestic production, plus imports, for an entire decade. The only thing of which we are sure is that Germany will be voracious for copper when the War is ended.

BY the operation of a new law, the State Mining Bureau now exercises supervision over the exploitation of the oilfields in California and will be in a position to remedy certain notorious abuses, especially the infiltration of water into productive wells. The State Mineralogist, Mr. Fletcher McN. Hamilton, has appointed Mr. R. P. McLaughlin as Oil and Gas Supervisor to carry out the provisions of the law. He will select four deputies to collect the necessary engineering data. However, the activities of these officials will be in the direction of instructing and aiding the operators rather than in subjecting them to irritating inquisition. We believe that all concerned will co-operate to the useful purpose designed by legislation and trust that it may prove a beneficial example of State supervision.

WE have been asked to discuss Mr. J. R. Finlay's interesting remarks, in the latest bulletin of the Mining and Metallurgical Society, on industrial energy as a military weapon, in which he says practically that a nation's greatness is measured in tons of pig-iron. Apart from the fact that we still consider human life to be guided and modified by the great imponderables, we deem it unwise to discuss problems so closely connected with the War and the natural prejudices arising therefrom. Most of our readers like to think that in picking up this journal they will derive information on matters outside the pervading horror of organized calamity.

ALREADY names are being mentioned for the directorship of the Bureau of Mines; that of Mr. H. Foster Bain has been mentioned for the office and steps were about to be taken to promote his candidacy. His many friends will be interested to learn that we sounded him on the matter and have received a reply, by cablegram, that he is not a candidate but desires earnestly to support Mr. Van H. Manning for the appointment. Mr. Manning was the loyal friend and assistant of the late Director, Joseph A. Holmes, and is now the Acting Director of the Bureau. We have every reason to believe that he would prove a fitting successor.

WE NOTE that the Canadian Mining Institute is discussing the granting of a medal in recognition of acts of bravery by workmen in and around mines and smelters. There is no question but that such medals are often deserved, for there is no braver man than the miner; the risks of his occupation make him fearless almost to recklessness. And in the discussion with regard to the granting of this medal the principal objection was that the knowledge of the offer of such a medal might make miners even more reckless. There is undoubtedly some force in this objection, for the desire to be thought a hero leads men to run needless risks; indeed, the record of mining accidents shows that more than three-fourths are due to some one's carelessness. Hence anything that tends to increase recklessness and carelessness should be avoided. On the whole we believe that the miner's contempt for danger needs to be repressed rather than encouraged and that the giving of such medals is likely to work contrary to the Safety

First principle. There is no reason, however, why brave deeds may not be rewarded in such other ways as seem just and expedient.

THRIFT is becoming fashionable, partly by precept but chiefly by force of hard times. Professional men are not remarkable as exponents of the Samuel Smiles idea, for their methods of life conduce to an open-handedness that rejects petty restrictions. In one direction at least they cannot afford to be niggardly, and that is in the acquirement of information. While thrift may lead a man rightly to avoid $5 dinners and to eat at a cafeteria, it ought not to shut-off his mental pabulum. In fact, when times are hard, and theatres and dances are too expensive for the lean purse, the time and money that are saved perforce may well be spent in buying books and in reading, preparatory for the days of activity ahead.

IN the latest bulletin of the Mining and Metallurgical Society of America we were glad to find an account of the testimonial dinner to Mr. Henry S. Munroe, on his retirement from the professorship of mining in Columbia University. The various speakers laid their wreaths of laurel at his feet with a grace befitting the occasion and the man they were honoring, yet, not unnaturally, we found the Professor's valedictory the most interesting of the speeches. At such times an earnest man is apt to tell not only the truth but the particular truths that he thinks may best further the cause in which his life has been spent. To his own students the speech must have been deeply interesting and touching in its good sense and sincerity. "In a school for the training of engineers—the men who do things—the instruction must be practical." "A mining engineer must first be an engineer." "His training must be broad and fundamental." These were salient points. In concluding, he spoke of instruction by lectures, indicating the weak and the strong features of this method of education. We commend his remarks to teachers of mining and metallurgy, for they embody 38 years of experience in a school of mines that has proved by its graduates that its methods cannot be far wrong. We join with the Columbia men in recognizing Professor Munroe's services to the profession and in wishing him many more years of health, happiness, and useful work.

Signs of Danger

With the extension of mining activity and the awakening of speculative interest there come divers printed invitations to buy stock in mining companies. We have two before us. One begins by quoting some extensive generalizations out of a Government report and then adds some warm commendations proposed by a 'professor' on the company's board of directors. The lack of quotation marks, particularly at the point dividing the official from the unofficial report, is a danger sign to a wide-awake speculator. It is a red flag. Next we find a photograph of a trench, so many of which now disfigure the face of the earth. This is described as a "shaft" in which the "ledge" was "tapped" at 32 feet. The assay of the ore is given as 49½% copper, 4.96% gold, and 1.17% silver. A rough calculation will prove that every ton must contain 1123 pounds of merchantable metals, worth over $30,000. Some mine that! Did the lucky discoverer proceed to take it out with his candlestick, his knife, or any other rudimentary tool? No; the shaft was "abandoned on account of the immense amount of water encountered therein." Yet it was on the top of a mountain. The story lacks verisimilitude. Let us dismiss it as unconvincing. Another mine, in Colorado, not in California, as was the last, is reported to consist of a large number of acres. Probably it does. It has a "true fissure vein." That is early Victorian; we have outgrown it. Average assays during the development period show $152.52 per ton "on this vein," which is 5 feet wide. That looks attractive. Besides two tunnels, the company owns "a flat formation" and "a titanium vein running the full length of the property." What is to hinder? The existence of two tunnels is explained by the necessity for fresh air; but this phase of mining requires air heated to a temperature capable of inflating a balloon. In the concluding paragraph it is asserted that the mine has "ore that cannot be all taken out for several years to come." We move to delete "all," in order to insure accuracy of statement. The stock is to be guaranteed by a redemption company at Rochester, N. Y., "as to principle, together with the endorsement of a large trust company." To endorse such principles not a trust company but the Y. M. C. A. or the W. C. T. U. ought to be engaged under heavy retainer.

Publicity and Advertising

Sweet are the uses of publicity, to those that understand them. Not long ago we received a call from a gentleman who had a grievance against a company that had obtained control of some mining claims formerly belonging to him, and had then done things that did not suit him. Whereupon he and a friend of his had prepared an article that we were invited to publish. It contained an *ex parte* statement of the case and was intended to hold the company up to public opprobrium. We told him that we could not lend any of our reading pages for the purpose of a private quarrel, and that if he wanted to publish a statement of his point of view, he could obtain the use of the necessary number of pages in our advertising supplement at the usual price per page, provided his statements were not libellous. Whereupon he said that he could send the 'story' to an Eastern non-technical magazine and get paid for it. "Yes," we retorted, "and have it treated as fiction." Of course, if he wanted publicity, we added, he ought to pay for it like a man and not expect to smuggle a partisan version of a business tangle into the reading pages of a paper. The incident is suggestive. Undoubtedly if a person wishes to make a statement to the public—in this case to the members of the profession and to the special public interested in mining—he should pay for the neces-

sary space on the advertising pages. Then the reader, seeing it, gives it at least the respectful attention due to a man who has paid money in order to get a hearing. There is no disguise. The reader is not irritated by going through an article that has editorial endorsement to the extent of being presented as a fair statement of a controversial matter, only to find when he has finished reading it that an attempt is being made to excite his prejudice. As a matter of fact, people often waste a lot of time and trouble in these devious ways when a direct appeal by advertisement would be vastly more effective. Suppose this man had taken four pages to tell his story in the advertising section, surely the mere fact of doing it in this straightforward way would have created a presumption of his good faith; undoubtedly his complaint would have been read with keen interest, and he would have obtained exactly what he wanted: publicity. Mr. Thomas Lawson, irresponsible and untrustworthy as he was in his self-imposed duty of advising the public, was clever enough to know this. When he wanted to catch the public eye, in order to give it one of his flamboyant messages, he did not waste time in suborning editors or in bribing publishers. He simply bought a page or more, according to his requirements, and told his story on it. The average man saw for himself that Mr. Lawson had paid the entrance fee to talk to him; having done so, the frenzied financier was entitled to a polite hearing. He got it, most effectually.

Another case within our recent experience is that of a man who had devised a machine, of which he, being the inventor, thought highly. He sent a contribution to 'Discussion,' under cover of which he advocated the use of his machine and expatiated on its merits. We told him that he would not deceive anybody, that his fond statements concerning the child of his brain were only interesting to the family, and that if he desired to interest the profession in his mechanical device, he had better buy an advertising page and tell his story in a businesslike way. He had not the money to manufacture the machine, which had only been tried once under his own personal directions; he did not like to put it into the hands of an established manufacturer—which seemed the most obvious thing to do—but he hoped to interest somebody either to finance him or to give him an order for a machine. Under these circumstances the best thing he could do was to invite participation or support by explaining the principle of his device and telling the plain truth to those likely to take an interest in the matter. He is still thinking over our suggestion.

Not long ago we received a description, by a writer not known to us, of a tool used in mining. It was a tool for supplementing the use of certain machines made by a well-known manufacturer and it referred to this manufacturer's products only. Like Sir Boyle Roche, we smelled a rat, we saw it floating in the air, and we nipped it in the bud. It looked like a write-up. An illustration, accompanying the text, had the appearance of being cut out of a catalogue. The description had been sent with a request for payment "at the usual rate." We replied that it was not suitable for publication as an independent article but that we would be glad to publish it, being interesting, under the heading of information "furnished by manufacturers." Our correspondent replied protesting that it was written on his own initiative and not in the interest of the manufacturer so plainly indicated. We returned the manuscript, but shortly after received a letter saying that the writer was in the employ of the manufacturer and would agree to the placing of the article as we had stipulated. As a matter of fact, the same information on an advertising page would have been more widely read and would have been more convincing. The average reader becomes irritated when he finds that an article purporting to be an unbiased technical description is really an ill-concealed advertisement. The reader expects the editor of a reputable paper to protect him against advertising that masquerades under the guise of detached technology; he loses his confidence in all reading matter when he detects the fact that some of it is being used to obtain commercial publicity under the guise of a scientific description. The engineer, who is our most honored reader, likes the reading matter and the advertising kept separate, to the gain of both; when they become confused, he cares for neither. When the reading page is misused, the advertising page is ignored. The advertiser who invades the reading page depreciates his own advertisement. The advertising pages of a paper are effective when the reading pages have won the complete confidence of those who are possible purchasers of the things advertised.

Should Directors Speculate?

This question was put recently by the New York *Annalist* to a number of men prominent in financial and corporation affairs. The replies are highly interesting as giving the public a trustworthy consensus of opinion on the part of those into whose hands the administration of corporate enterprise is consigned. Our readers will agree that in these matters it is well that there should be a clear understanding.

In the investigation mentioned, it was ascertained that "all but a few" of the directors considered that they had "a right" to use the information coming to them in their official capacity, that is, to use it for the purpose of their own profit. They were in general agreement that "a director is not a trustee for the rest of the stockholders," so that he is "free to convert his inside information into market profit, if he can." Indeed, the fact that such trading on inside information may prove to be unprofitable is suggested as some sort of justification, on the basis that the taking of risk absolves a director from the charge of taking an undue advantage. One of the replies may be taken as typical:

"If we were all Christian gentlemen with a very fine sense of honor, I suppose no director would buy or sell stocks in his own company on information which comes to him as a director. As a practical matter nearly all directors do. If a director was a trustee, it would be a

different matter, but as far as I see, he is not that. He is an administrator on behalf of himself and of other stockholders, but he does not surrender his individual freedom when he becomes a director. If it were held that a man's holdings of a stock should be frozen up the moment he becomes a director, he being put under obligation neither to add to them nor to reduce them, I fancy very few could be induced to become directors." This statement has the merit of frankness. In his further reply, the non-Christian gentleman with no excessive sense of honor, but for all that probably a more trustworthy man than many who make loud protestations, states that while it might be "rather raw" for a director to sell stock on fore-knowledge that a dividend was about to be passed, yet he would be "within his rights." This 'right' to make money on the side, and by use of confidential information, is excused on the further ground that the director's fees afford no adequate compensation for the time and trouble consumed in the management of corporate affairs. Therefore, the director is entitled to make use of the advantage that accrues to him from priority of information. But this witness is frank enough to conclude by saying that "it might be better if directors were paid a sum commensurate with their service and were then barred from dealing in their own stock, but as a practical matter it is not so."

Here we have the case stated plainly. While no particular reference is made to mining companies, it is obvious that the argument affects them particularly on account of the fact that discoveries of rich ore and the other recognized vicissitudes of mining afford unusual opportunities for using inside information to gamble in shares.

The subject is as old as the joint-stock method of operating industrial enterprise. The mere fact that the question can be put to responsible men suggests a growing opinion that speculation by directors is wrong. To that extent the discussion is an excellent sign. Nobody asks whether a director is free to go to the cash-box and help himself; nobody wants to know whether it is proper for a man to sell short on his partner; nobody raises the point as to the propriety of a trustee using his trust for private gain. We have settled those doubtful points long ago.

In discussions of this kind it is essential to start with a definition of the principal terms used. An attempt to define the terms employed often goes far to answering the question at issue. A 'director' is one that directs; he is also one that superintends or manages. To 'speculate' is to take the risk of loss in view of possible gain; it is to apply money upon an uncertainty in the hope of profit; it is to bet on one's judgment in the expectation of making a killing. If a director be one that superintends and manages his own personal affairs only then his actions do not concern the present inquiry. Obviously he is one that manages the affairs of others. Therefore he is in a fiduciary position. We do not accept the denial of trusteeship; that is implicit in a position involving the use of other people's money. If he speculates in the true meaning of the word, which involves risk, he is not doing what is most objectionable. The underlying objection is to a gentleman betting on a certainty. When he has information to which others equally entitled will obtain access after he has bought or sold shares, he does not 'speculate,' he steals a march on them. As the non-Christian and not too sensitive witness for the defense said, in regard to acting on fore-knowledge of a dividend, it is "rather raw." In short, our view has always been that directors are trustees, not privileged speculators; they represent all the shareholders, not themselves or their group of friends only; we maintain that the shareholders as a whole are the owners of the mine and that the directors are merely officers elected to protect the interests of those shareholders—all of them.

As to the meagreness of their emolument as directors, this is a pitiful excuse. A man's honor is not supposed to vary with his salary. And though it is evidently impossible to pay a dishonest man enough to keep him from cheating, which is really what acting on advance information means, yet if shareholders expect the wholehearted service of their company-officers they should pay them for their time and trouble. In London, where joint-stock finance has been so largely developed, it has become the custom to pay, not a mere fee, but a salary of £100 to £200 per annum, with double the amount to the chairman. Of course, in the more important enterprises the pay is bigger. The fee of a guinea per meeting only lingers now in the nickname of 'guinea-pig,' given to those who appear to go on the boards of companies in order to get pocket-money. As a rule, the type of man trained in company affairs and in a particular business will be a director on several boards, so that he may be in receipt of a considerable income from this particular source. In any case, inadequacy of remuneration cannot be given as an excuse for share-dealings on the side. In this country the fee of $5 or $10 for attending the relatively infrequent meetings of a mining-company directorate is a belated anachronism. Directors ought to be paid for their time by the shareholders for whom they ought to be working. And when the existing custom is changed, we hope that the British mistake of having large boards—of 7 or 9 directors—will be avoided. In the end a board is likely to be dominated by one man, with the others to advise or to divide the responsibility. The ideal administration should consist of a managing director with two assistants, and at their meetings the consulting engineer should be present *ex officio*. However, to return to our immediate subject, it is obvious that whether a man be paid $20 or $2000 per annum for his services as a manager of the affairs of his fellow-shareholders, it does not discount his obligation to not take advantage of a place of trust. If the method of raising capital for mining ventures by issuing shares to the public is to be placed on a sound basis, it is imperative that the status of a director should be properly defined. This can be done, not by legislation, but by crystallizing public opinion on the subject, by discussions such as that started by *The Annalist*. We shall return to the matter in a later issue.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Mining Claims in National Forests

The Editor:

Sir—That Mr. Barrett understands the intent of Congress is evident when he says: "Congress recognized that in establishing National Forests covering the main mountain ranges of the West—for the purpose of conserving water and growing timber, etc." That is exactly what Congress intended, and in making the Forest Reserve cover the watersheds it would, of course, be unavoidable in places to take in mineral land, and in order to protect a watershed it might be necessary to include agricultural land and plant it with trees. What Forest Reserve people overlook is that it was the intent of Congress to protect the watersheds and do nothing else. Does Mr. Barrett claim that Congress authorized the making of a Forest Reserve out of the sagebrush deserts or is it forbidden by the section of the statute I quoted. It is hardly necessary to point out that water-power sites are always in the valleys of streams, while the lawful home of the Forest Reserve is on the top of the mountain. It is only necessary to refer to the bulletins issued by the Forest Service to prove that most of its activities have nothing to do with the protection of the watersheds. There is not a word in the statute that can be construed to authorize the employment of veterinary surgeons to care for the disease of livestock or of mining experts to report on mining properties. It would take up too much of your space to quote from Forest Service bulletins and other official records to prove that these charges of usurpation are not baseless. Bearing in mind the old maxim "*falsus in uno, falsus in omnibus*," let us consider the case of the Forest Reserve covering the mudflats on the shore of Controller bay in Alaska and admit if you will that President Roosevelt established this Reserve in a fit of absence of mind without considering the absurdity of making a Forest Reserve out of tide-lands. When President Taft restored a portion of these flats to the public domain, the Forest Service, led by Mr. Pinchot, made a bitter and venomous attack on him. Will Mr. Barrett explain why this attack was made on Mr. Taft for doing his duty, unless the charge is true that the Forest Service wanted these flats for some purpose besides the raising of trees and conservation of water? The principal object of a discussion of this kind is to call attention to the importance of obeying both the spirit and the letter of the law. The law authorizing the establishment of Forest Reserves was sufficient if any attempt had been made to carry out the plain intent of Congress. It was beyond question the interest of Congress to establish Forest Reserves to protect the watersheds of our streams, and for no other purpose. Care should have been taken to establish the boundaries of these reserves so that they would be perpetual. If these reserves are needed now the necessity will increase as the years go by. They should be in charge of expert foresters, who should devote their time to the care of trees. The control of livestock ranges, the regulation of coal mines and water-power sites, and the care of forests outside the Forest Reserves are matters to be entrusted to the Secretary of the Interior, and the rights that citizens have on the public domain should be defined by law. It is only necessary to read the Forest Reserve use-book to see that the rights of citizens on a large part of the public domain depend upon the will of the forester and a permit granted today can be revoked tomorrow. What Western people ask is regulation by law.

H. W. Reed.

Salt Lake City, August 4.

Do Engineers Talk Enough?

The Editor:

Sir—The men who make the most money in mining, as in general business, are those who talk. The rarest quality in the systematized conduct of industry is the ability to talk well when there is opportunity. New ventures are undertaken, and businesses built up, enlarged, or made more profitable, by someone who expresses his ideas in words that convince.

An engineer tends toward paucity of speech, toward brief utterances, and toward consistency. Frequently the man who is employing him gets out of patience with his pedantic narrowness of view; very likely the employer made his money by his failure to be consistent, by his visions, his accomplishing 'after a fashion' things that engineers said "cannot be done." The conversations of financiers, men of affairs and directors smack of inconsistencies, irrelevancies, dilution, and changes of purpose.

The men who hire engineers (and in whose positions engineers long to be) have the courage and the initiative to start a new business, prospect, or phase of things; to see it sink into failure; and then to find a way out. They can forget an original collapse of their hopes, and out of the muddle of their first purpose, build a side issue that is as good, or better, than the results they had tried for. Through all the trials, changes, and inconsistencies, they must talk, and think aloud, say things they don't mean for the sake of hearing how they sound, converse with

associates to get new ideas and suggestions. And here is where the typical engineer falls down. He lacks the ability to talk; he is pessimistic, dumb, and suggestionless; he is frightened by glaring contradictions to what he had learned; he is barren of constructive ideas unless they be along lines with which he has been accustomed.

The most able men in business are those who understand how to handle and draw out other men in the same business, their superiors in position as well as their inferiors; those men who know conditions; who can recognize ability mixed with inability, who convince others that *their* way is the way things get done. A man's associates in business are part of his stock-in-trade; they make it possible for him to achieve his plans, to reach other men, and to carry his point. And the quality and quantity of one's associates are determined largely by one's ability to talk.

The average engineer does not appreciate that in this country, and in this particular trend of the world's affairs, there is an immense amount of dilution in business —and in talk. Long conversations take place in New York, Boston, London, on trains and steamers, underground and in the hills, which would assay only about one-tenth of 1% in importance; the balance being preliminary, irrelevant, inconsistent, bluff, hope, fear, feeling-the-way, and filling in. But it is all more or less necessary, because it is the way things get accomplished in these days of loose aggregations of business units and of ramified finance.

An engineer, when he gets around to say something, usually means exactly what he says. That makes him a good engineer, after a fashion. But if he aspires to bigger game, to doing things for himself, or to being a part of big affairs, he learns to talk more. He finds out that, unlike engineers, other men (including the 'big men' of finance, and their associates) say many things that they don't mean. Some things they say because they wish they were so, others are highly colored exaggerations uttered for the purpose of cheering themselves up, still others are underestimated little details that nearly everyone knows are due to this reason or that, and must be allowed for. In other words, to accomplish big things, one must expect many inconsistencies, much that 'shouldn't be so' but 'is,' numerous peculiarities, exceptions, and disproportions, and through it all, talking is necessary, to fill in, to satisfy, to lead on, to give suggestions, and to create.

Does the engineer talk enough? Perhaps he does for an engineer. But these are hard times for engineers who can only engineer. An engineer who talks enough for an engineer, may not talk enough for his own best good. Few engineers care so much for engineering, simple and unadulterated, that they wouldn't mix it with something more profitable. The answer is, learn to talk.

Not necessarily is a good talker one who talks a lot. But it is better to talk a lot, say a little worth while, and interest somebody, than to say nothing at all. Great matters spring from trivial remarks, and a chance conversation may be the means of important developments. On the other hand, one should not become a bore. A good talker, rather than one who talks a lot, is one who has a respect for talk, who listens well, puts in a reasonably practical remark, and who makes allowances for talk that is only talk.

Important talks, concerning good-sized issues, are difficult matters to plan in advance, and rarely do they come about just as planned. There is always the other man to be considered, with his personal ideas, feelings, prejudices, and general health, all having a bearing on the interview. Still, while it is useless to plan out one's line of talk in advance for any particular interview, it is well to have in mind a clear idea of the points of the case, carefully threshed out. After one has heard the other party to the meeting utter his first few words, he can decide on what tack to approach him and work in the particular points he wishes to bring out.

Men get important positions, commissions, and privileges, because they are believed in and trusted by those in power. They get believed in because they have talked and made an impression; they said things that appealed to somebody; they struck a point of view that supplied what was lacking. They were convincing, sincere, plausible; and it looked as though what they said was right. A successful man may know much less about his own business than one of his under-paid engineers, but he talked and made the business. It is his business. If an engineer can talk, he stands a chance of being able to sell his talking for more than his engineering. That is, the talking will greatly enhance the engineering. Everyone is susceptible to the right kind of talk, even captains of industry and capitalists who care little for engineering.

Of course there are times when "silence is golden," and much is gained by knowing when to keep still. But a man should say something once in a while, and he should make himself interesting when he talks, and not confine himself to technical utterances, and 'knocking.' He can undoubtedly 'hold his job' by keeping still and saying nothing, but he'll be further ahead in ten years, and will have lived more, by cultivating the knack of talking, so that when the opportunity presents he can direct the conversation and impress his personality and abilities on someone whom he desires to impress, rather than keeping still and thinking what he'd like to say if he dared. A man who can talk and 'put a thing through,' who gets listened to with attention, who can interest and convince his hearers, will get along. A good talker needn't be an orator, nor a liar, nor a bluffer, but he should know how to attract attention to himself when he sees that he can gain something worth while by doing so. Talking that convinces, that sounds like 'the way out,' that clears matters up, is valuable. 'Tis a great thing, talking; we all fall for it.

P. B. McDonald.

Gouverneur, N. Y., August 2.

Operating units should be worked to full capacity. A zinc-lead mine in southwest Missouri formerly hoisted 2,300,000 tons of ore through 24 shafts. By changes in the transportation system 13 of the shafts were abandoned and a yearly saving made of $1,000,000.

Platinum Assaying at the Boss Mine

By FRANK A. CRAMPTON

Upon assuming my duties as assistant superintendent at the Boss mine, Goodsprings, Nevada, it became apparent at once that some assaying method must be devised rapid enough to test the daily samples and yet secure a commercial degree of accuracy. When it is understood that the assay for gold, copper, platinum, palladium, and at times silver, in the same sample must be completed in time for the next lot (say of from ten to twenty samples) it at once becomes apparent to the assayer that methods involving less than two to four days must be devised. It will be interesting to follow the course pursued in eliminating the older methods and developing the new. Each of the standard methods had its strong points, but the vital factor of time made each out of the question for our purpose, especially as these methods required, in most cases, from three to five assay-tons, of which the fusion and cupelling alone would take nearly a day.

The first method used is the one chiefly in vogue on the Pacific Coast, the procedure being the same as with gold, only, instead of the smaller charge of a half or one assay-ton, 5 A. T. is required; an estimated amount of silver, equal to at least 12 times the amount of platinum, being added to the fusion. After cupelling, the button is parted in dilute HNO_3, then in concentrated HNO_3, leaving the gold as residue. The silver is precipitated with HCl, added drop by drop, the solution being then filtered twice and washed thoroughly. Silver-free zinc-dust is added in excess of any acid reaction, the solution filtered, the filter-paper dried and ignited, a known amount of silver added, and the whole then mixed with a proper flux and reduced to a lead button. Proof-silver is run alongside this, and in weighing the cupelled buttons the loss in silver is used as a correction on the Pt-Pd button. This method proved unreliable, as the zinc invariably precipitated some of the silver still in solution, resulting in silver being weighed as platinum-palladium.

Another method, described by J. Ohly, in his 'Analysis, Detection and Commerical Value of the Rare Metals,' on pp. 79-82, was used in combination, so as to include both platinum and palladium. This method, though accurate and by far the most satisfactory of any of those used, took more time than could be given, inasmuch as the treatment necessitated an additional step: not combining the two elements in one single operation but allowing the use of the same solution throughout. As copper in the ore interfered and complicated the assay, Ohly's method for eliminating this element (page 86) was used.

Ricketts & Miller, in 'Notes on Assaying,' pp. 130-135, give two methods for the determination of platinum. In the assaying at the Boss mine, palladium must also be determined. To do so by this method, a complicated series of steps is necessary, involving the method described by Ohly as well as the addition of formic acid. The method naturally took more than the available time, but for accuracy of results compared favorably with the others.

Furman, in 'A Manual of Practical Assaying,' pp. 310-311 and 246-249, gives the assay for gold bullion. This was modified with several additions in such a manner as to allow the assaying of ore to determine the palladium. The method is very clumsy, though as accurate as the others. Another method noted, but not used on account of its length, was recently described in the *Mining Journal* of New York. Other schemes, not worthy of mention on account of their unreliability, were tried and, though aiding, each in a small way, in devising the final method, cannot in themselves be termed worthy of note.

The method now in use, the one finally developed, makes use of the solution after parting platinum, palladium, and silver from the gold in an ordinary assay upon ½ to 1 A.T. of pulp, depending upon the content. In assaying hundreds of samples, the assayer is soon able readily to distinguish a low-grade from a high-grade ore. Silver, estimated at about 15 times the platinum-palladium content, is added to the crucible-charge. The fusion is made at a high heat throughout, and in cupelling the lead button a moderately high heat is maintained: a heat above that required to 'flower' being the more satisfactory. The button is parted first in ordinary dilute nitric acid, and when the parting is apparently complete, 5 c.c. of concentrated nitric acid is added and boiled 10 minutes. Then pour into a casserole; the residue (gold) is washed in a 1 to 10 solution of nitric acid and the washings added to the casserole; the assay for gold is then finished in the ordinary way.

At first the solution was taken up in HCl after evaporation, and the silver eliminated by filtering twice. This step, however, proved unsatisfactory, owing to there being some silver still in solution. This, when the platinum-palladium content is above 2 oz. per ton, has a tendency to precipitate with them. The discovery led to a development of the present method, after the use of HCl was discarded. The precipitation of the platinum-palladium is somewhat the same, without alcohol and without boiling prior to adding formic acid.

The present method, after parting the gold, takes less than three hours for 20 samples and is conducted as follows: The silver is precipitated by a super-saturated solution of sodium chloride, filtered first with a wash, then re-filtered without a wash. The filtrate is neutralized with ammonium-hydrate in slight excess and brought

to a boil. Formic acid is then added till the solution becomes distinctly acid, even strongly so, and boiled briskly for from 20 to 30 minutes. (If the platinum content is high, 10 to 15 c.c. alcohol is added after the formic acid. This is readily determined, as the parted solution shows strongly yellow if over ½-oz. per ton platinum-palladium is present.) After boiling, the solution is filtered without washing, the filter-paper dried, ignited, and the residue wrapped in lead-foil and cupelled, allowing the completely cupelled button to remain in the muffle about 10 minutes more and raising the heat. The resulting button is weighed and recorded as platinum-palladium, a further parting not being necessary for ordinary purposes. It is not necessary, but preferable, to ignite the filter-paper; this, however, can be omitted and the filter-paper wrapped in lead-foil and cupelled. The difference in results is very slight, but in favor of ignition first. The results of tests are given below:

Sample No.	1.	2.	3.	4.	5.
Filter ignited	0.63	0.18	0.32	0.07	2.42
Filter cupelled	0.61	0.18	0.31	0.07	2.38

the error being a little more than 1%.

When a silver determination is necessary, a known amount is added, the button weighed before parting; after the gold and platinum-palladium assay is complete, the silver content is readily computed by difference. It is well to run a proof at the same time for correction purposes.

The following table is inserted in order to compare the various results by the different methods. They were picked at random from a score of comparative assays, and for the three grades of ore. These results are averaged from three assays each on each method employed and on the same pulps:

	High grade.		Medium grade.		Low grade.	
Method.	Au, oz.	Pt-Pd, oz.	Au, oz.	Pt-Pd, oz.	Au, oz.	Pt-Pd, oz.
J. Ohly	79.62	246.12	1.53	0.67	0.18	0.22
Zinc-dust	81.33	272.48	1.51	0.84	0.18	0.31
Ricketts No. 1	80.86	233.19	1.53	0.51	0.18	0.16
Ricketts No. 2	84.37	239.63	1.53	0.54	0.17	0.19
Furman	82.66	249.37	1.52	0.65	0.18	0.20
New (no alcohol)	81.99	245.83	1.53	0.67	0.18	0.20
New (alcohol)	82.87	247.21	1.53	0.69	0.18	0.21

It is probable that the lower platinum-palladium results by the Ricketts & Miller method are due to the incomplete precipitation of palladium, while the high assay by the zinc-dust method is due, of course, to silver being weighed with the button, having been precipitated by the zinc. Otherwise, the table speaks for itself.

It can be seen at a glance that the new method compares most favorably with the older ones. Inasmuch as the assay for gold was made on all the samples, it is inserted, though it has no distinct bearing on the platinum-palladium assay. Assays for comparison on the silver were not made, but it is reasonable to expect that the check would be as close as in any other silver assay.

Extreme accuracy is not claimed for the method, but merely an accuracy commensurate with the relative importance of daily samples for a mine in process of being developed. It is only fair, however, to say that 0.05 to 0.06 would be the extreme error per ounce of platinum-palladium, by this method.

It is a pertinent fact, and one worthy of note, that reports on samples of pulp first assayed at the mine and then sent to representative and reliable assayers would show a wide variation from each other, and a sample of the same pulp, submitted to one assayer was reported differently each time. This seems to be the rule rather than the exception, and naturally leads one to the conclusion that assayers either are not familiar enough with the determination of platinum or show a marked degree of carelessness. Possibly the methods employed are not the proper ones; at any rate there is something wrong. The following table, on the assay of six samples, is inserted for comparison:

Assayer.	1.	2.	3.	4.	5.	6.
Self	0.16	1.15	0.11	1.18	0.11	0.65
No. 1	0.32	...	...	...	0.08	0.76
No. 2	...	0.82	0.07	...	0.03	...
No. 3	...	...	0.32	3.57	...	0.48

The results, of course, are for platinum-palladium only. It is hard to tell which are correct and which are not; the wide variation would seem to indicate, however, that the proof of accuracy is yet a factor to be determined and that co-operation and the exchange of ores as well as of notes by the different assayers would be a step in the right direction. It would appear to me that the more numerous the steps in an assay, the greater the chance of error. The elimination, wherever possible, of all but the basic steps, lessens the chance of loss and gives results more uniform throughout. The following table of an assay on the same ore by two methods, both comparatively short, the shorter being the Boss method, shows the variation to be wide, even when conducted by the same assayer.

Ohly method.	Boss method.
1.61 –0.73	1.62 –0.69
1.64 –0.70	1.64 –0.71
1.62 –0.62	1.62 –0.66
1.62 –0.66	1.62 –0.69
Average 1.622–0.677	1.625–0.687

The averages here check as well as could be desired; however, an extreme variation of 0.11 oz. is noted by one method and 0.05 oz. by the other, a little too much for even commercial work on metals of which each 0.01 oz. is equal to 40 cents.

I do not claim any originality for the new method, and wish to give due credit to the aid afforded by older ones. The Pacific Platinum works uses, it is understood, a formic acid method similar to the one in use at the Boss mine, and it is primarily through study of that method that the present one was evolved.

COPPER AND SULPHUR DEPOSITS are reported to have been discovered in the Planchon pass, between the Colorado and Atuel rivers, province of Mendoza, Argentina. Their altitude is about 6500 ft., according to a consular report of June 12 from Rosario.

The Hydraulic Compression of Air

By A. E. CHODZKO*

It is interesting to the student of coördination of the development of industrial progress to note the features in its processes of evolution that are common to different lines, and in no division, perhaps, of that vast subject are they more conspicuous than in the generation and the utilization of motive power.

For instance, a jet of steam impinging upon vanes or buckets attached to the periphery of a wheel, or else issuing from a point of its rim, was the first concrete form of a steam-motor; it now represents the most advanced type of that class of machinery, after an interval of many centuries, although the far more intricate reciprocating engine was gradually developed in the meantime. The direct use of air under pressure for raising water, which in the light of modern familiarity with their practical combination, offers an efficient method of pumping, was distinctly outlined in the well known 'Fountain of Heron.' Nevertheless, this early suggestion remained unheeded until many elaborate designs of pumping machinery had gradually been evolved and perfected. The same is true of the compression of air. The crude and classical *trompe Catalane*, used for forge-blast in the small charcoal-iron factories of southern France, had long been relegated to the position of a mechanical curiosity, and been superseded by motor-operated fans.

As higher air-pressures were demanded, the piston machine was developed to a remarkable degree of excellence. It was followed, in course of time, by the high-pressure centrifugal, better adapted to large capacities. Continued progress in that direction has brought back a process primarily based on the principle of the ancient *trompe*, namely, the hydraulic compressor.

Two main features seem to characterize this gradual progress of human ingenuity; the first, of a general, not to say universal nature, is the tendency of advancing knowledge toward a return from the complex to the simple. In almost every industrial effort, the desired object is first attained by some intricate and cumbersome process or device. This is followed by a gradual blending of its useful elements into a smaller number. Later comes the weeding out of unnecessary intermediates between power and resistance. The second tendency, less general perhaps than the former, because it admits of of some exceptions, is the discarding of intermittent in favor of continuous motion. These exceptions are found in cases where great variation of speed or frequent reversals in the direction of motion are a necessity; they do not detract, however, from the logical and general character of that tendency.

The hydraulic compression of air is the subject of the present paper. This can hardly be termed a novel process, since, aside from the remote origin already indicated, the first patent covering its application on a large scale was taken out by Joseph P. Frizell in 1878. The following quotation from his treatise on 'Water Power' gives a comprehensive presentation of the principal features of that process.

"It is founded upon the familiar observation that water thrown into commotion breaks into foam, and becomes impregnated with minute air-bubbles, and upon the further fact that these bubbles rise through water with a very moderate velocity, and in a descending current, are carried downward and subjected to a pressure conformable to the depth. Fig. 1 shows the arrangement for applying these principles on a practical scale. It assumes a fall created by a dam on a running stream. It

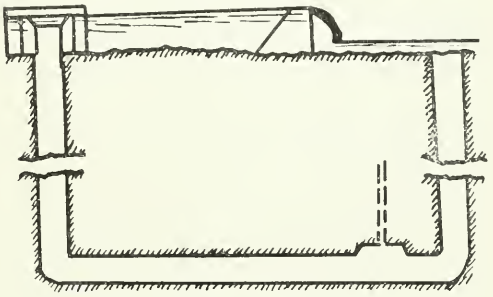


Fig. 1. SKETCH OF FRIZELL COMPRESSOR.

also assumes, what is generally the fact at a fall or rapid, a rock formation at no great depth. On the up-stream side of the dam, a vertical shaft descends into the ground to a depth corresponding to the required pressure. At that depth, its direction changes to horizontal, and it pursues this course to a point below the dam, where it joins a second vertical shaft opening into the river. Around the entrance to the shaft, a masonry structure rises to the elevation of the dam or something more, and is provided with means for controlling the influx. Over the horizontal passage, a capacious chamber is formed, provided with an impervious lining. The air-transmission pipe leads from this chamber. Water entering the descending shaft from different directions, meets with a high relative velocity, and is thrown into violent commotion which impregnates it with air-bubbles of a minute and very uniform size; such bubbles tend to rise with a velocity of no more than one foot per second, and the descending current being four feet or more, they are carried downward. In the horizontal part of the passage, the air is free to rise and accordingly enters the air-chamber, and there accumulates under a pressure corresponding to the depth of the surface of water in the chamber below the surface of the stream. The water divested of its burden of air pursues its course, and rising through the ascending shaft, joins the river.

*Consulting engineer, Phelan Bdg., San Francisco.

"The compression in this method takes place isothermally, and avoids one of the principal sources of loss in machine-compressors. The losses inherent in the method are:

1. The head expended in impregnating the water with air, which includes the head due to the initial velocity, a fall of one foot in entering the shaft, brings in the water from both sides with a velocity of eight feet per second, and these two currents meet with a relative velocity of sixteen feet per second, which creates a sufficient commotion.

2. A loss which may be called the 'slip' due to the velocity with which the bubbles tend to rise. It is obvious that the rise of the bubbles during the descent of the water is a lost motion, to be deducted from the efficiency of the system.

3. The head consumed by the friction in the channels.

"A committee of the Franklin Institute gave its attention to this method, and in a formal report, pronounced it identical with the ancient *trompe*. This statement is entirely incorrect, and reflects little credit upon that time-honored institution. The conclusive and indisputable criterion between the two methods is this: The *trompe* cannot produce a pressure equal to the working head, or closely approaching the same. The device under consideration can produce a pressure many times the working head."

Considering the device on its general lines, a certain volume of water in the intake is allowed to fall into a vertical shaft, entraining by suction and by adhesion some atmospheric air, and gradually compressing it. The falling water is then deflected through a horizontal passage, where it meets a collecting-chamber. At this point the air, through its buoyancy, separates from the water and is led by a pipe to any place where it is intended to use it. The water from which the air has been separated is again deflected up another vertical shaft leading to the tail-race.

In the complete device there is but one piece of machinery, namely, the controlling-device for the admission of air and water. This device is practically stationary. No attendance is necessary, and if the shafts and passages have been carefully built and secured against leakage or caving by erosion, there is no apparent reason for considering it other than a permanent structure unless, perhaps, in the case of unusually gritty water.

It may be noted that aside from the small amount of air that might remain in suspension in the escaping water, the latter reaches the tail-race in the same condition as to pressure as when it left the intake. The work performed is therefore due to the fall of a certain volume of water from a height equal to the difference in elevation between them. This quantity may be computed exactly.

Whatever intermediate process may take place in transit between these two terminals, the result is the production of a certain volume of compressed air, capable of yielding an amount of useful work that can likewise be correctly determined. The practical efficiency of the system is the ratio of these two quantities of work. In practice efficiencies have been obtained comparing favorably with the most elaborate air-compressing plants.

It will be seen that the air-pressure depends solely upon the depth of the return-shaft leading to the tail-race, and is therefore apparently independent of the head. This, however, is not strictly true. A higher working-head is necessary for an increased air-pressure.

The experimental results realized with the Frizell hydraulic compressor led Chas. H. Taylor of Montreal, Canada, to propose a modified form of that machine. A machine of this type was erected in 1896 at the Dominion Cotton Mills, Magog, Quebec.

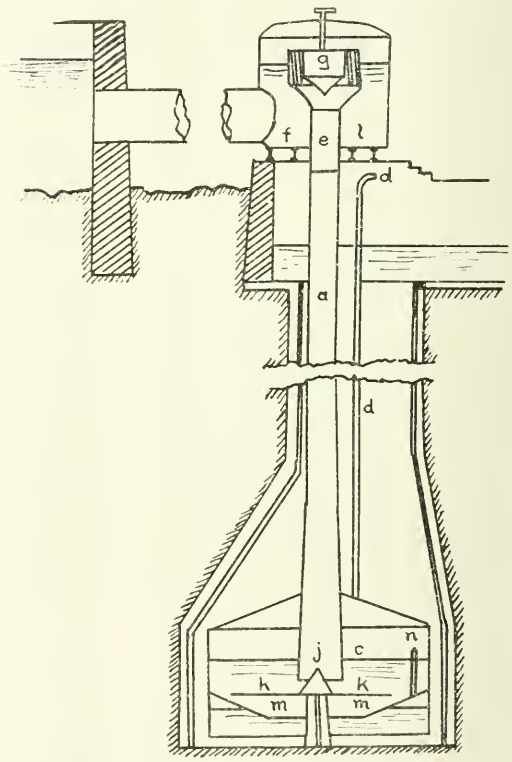


FIG. 2. SKETCH OF TAYLOR COMPRESSOR.

Fig. 2 is a sketch of the compressor used in that instance, taken, together with the following abridged description, from 'Compressed Air Plant,' by Robert Peele. "For the Magog Mills, a 128-ft. shaft was sunk to give the desired head and pressure: in it was erected a large vertical compressing-pipe *a*, 3 ft. $8\frac{1}{2}$ in. in diameter, the lower part gradually increasing to 4 ft. 8 in. and made of $\frac{5}{16}$ in. steel plate. This pipe passes through the bottom of a cylindrical intake *b*, 12 feet in diameter by 12 ft. high, connected to the supply flume. The pipe extends to a point a few feet above the bottom of the shaft, passing through the top of a cylindrical bell *c*, 17 feet in diameter and 12 feet high. This bell, entirely similar to those used for the storage of illuminating gas,

is open at its lower end, and supported about 18 inches above the bottom of the shaft, the top of which opens into the tail-race. The bell is entirely immersed in the return-water. Immediately under the open lower end of the pipe, *a*, a deflecting cone *j*, attached to a horizontal circular baffle-plate *k*, about 14 ft. in diameter, is secured at the centre of bell *c*. A pipe *d*, attached to the top of that bell, leads the compressed air to any place intended for its use. Returning to the top of the pipe, *a* in the intake, one finds a telescopic section *e*, riveted to a bell-mouth *f*. Immediately above this is a cylindrical head-piece *g*, open at its top and terminating below in an inverted conoid that penetrates the bell-mouth *f*. The head-piece is suspended to a central screw, by means of which it may be raised or lowered at will. This regulates the size of the circular inlet of water into the pipe *a*. The head-piece carries on its periphery thirty 2-in. iron pipes 4 ft. long, open at the top, which projects above the water-level in the intake. Into each of these and close to its lower end, are screwed thirty-two short horizontal ¾-in. pipes directed into the annular inlet-opening.

As the inrushing water passes among the small pipes, it tends to create a vacuum. Atmospheric pressure drives the air through the pipes in the form of small bubbles entrained by the water. With the water, they are carried down pipe *a*, their pressure increasing with the depth below the surface. As this emulsion of air and water issues from the pipe, it impinges against the baffle-shield *jk*. Its flow is abruptly swerved radially and at right angles, while the area of the stream is considerably increased. Its velocity decreases accordingly, and the bubbles, rising to the surface, are collected into the receiver formed by the upper portion of the bell *c*. The water, having lost most of the entrained air, is deflected by an apron *m*, toward the centre of the bell, and continues on its way to the tail-race. In so doing it follows the slanting outer face of the apron *m*. The remaining air collects at its connection with the plate *k*, and is led by the pipe *n*, to the receiver, and thence, through the pipe *d*, to the place of use.

The minute subdivision of the air increases its surface of contact with the cooling water to a great extent. The compression has been found to be actually isothermal. In a series of tests made by C. H. McLeod of McGill University in August 1896, the best efficiency in the Magog plant was found to be 62.4% with an effective air-pressure of 52 lb. gauge. This was realized with a delivery of 4005 cu. ft. of water, entraining 1095 cu. ft. of free air, per minute, the available head being 22.3 feet. Subsequent experience with this system has shown that the parts were not correctly proportioned in that first installation, and greater efficiencies have been realized in more recent application."

The same source of information mentions a plant built for the Kootenay Air Supply Co. at Ainsworth, British Columbia. The first portion of the induction pipe *a*, Fig. 2, which is 33 in. in diameter, is carried on a wooden tower 110 ft. high, whose base is at the level of the tail-race, and continued by a vertical shaft 105 ft. deep, the effective compressing-head being 107 ft. The main pipe-line 9 in. in diameter, is two miles long. It discharges from 4200 to 4600 cu. ft. of free air per minute, producing 600 hp. after compression. The volume of water and the efficiency are not mentioned. Owing to improved constructive features, the latter must have reached, if not exceeded 70%.

Another large plant was built in 1906 at the Victoria Copper Mine, Ontonagon Co., Michigan, containing three units in all. In one of them, with a working head of 70 ft., 14,820 cu. ft. of water was used to deliver 11,930 cu. ft. per minute at 114 lb. gauge-pressure, corresponding to 1623 hp. and an efficiency of 82.27%. It is expected that the three units will deliver 4000 hp. in all. The single unit at present in use operates, among other machines, a 500 hp. hoist designed for 4000 ft. beside seven pumps. The cost per horse-power per year is $2.25, including all operating expenses.

Other recent installations are, two in Germany and one on the Shetucket river, near Norwich, Connecticut. The latter plant was described in 'Compressed Air,' in April 1906. An underground plant developing about 60 hp. has been constructed in the silver mines of Clausthal, Bohemia.

The most important point of difference between the Taylor and the Frizell designs lies in the process adopted to induce the entrainment of air at the intake. The former uses a large number of small inlet-pipes, 1800 being used at the Victoria Mine. That is, it carries the preliminary subdivision of the air intended for compression as far as possible, apparently with the idea of increasing the cooling-surface. In the Frizell compressor, the head-piece consists of a funnel, in the shape of a square truncated pyramid, with its apex downward, attached to a telescopic piece of pipe. The following excerpt is from Frizell's 'Water Power.'

"Fig. 1 shows a telescopic pipe entering the descending shaft, carrying a hopper-shaped mouthpiece, which we will call the 'hopper,' and adjustable vertically by mechanism not shown. The hopper is guided in its vertical movement by four piers or guides. These form four channels of approach, through which four currents of water enter the hopper, and in meeting cause the necessary commotion. It was clearly shown by the writer's experiments at Minneapolis, in 1880, that throwing the water in commotion is an effective mode of impregnating it with air.

"Any arrangement of pipes for this purpose appears to the writer entirely superfluous as well as objectionable. The pipes could not fail at times to become clogged with floating debris to the extent of wholly arresting the flow of air. In the arrangement of Fig. 1, trash of every kind, blocks of ice, and even logs could go through the system without embarrassment or interruption, not even a rack being required. In this disposition, the position of the hopper determines the quantity of water drawn. The quantity of air regulates itself, and is neither more nor less than the given quantity of water can carry. If the descending column is so loaded with air that it does not preponderate sufficiently against the ascending column,

the water in the former will rise, the commotion will diminish, and less air will enter. In the contrary case, the water falls, commotion increases, and more air is taken in."

In the presence of two different designs, both evolved by persons of evident technical qualifications, and both founded on actual experience, a third party not possessing the latter advantage, can offer no comment other than remarks suggested by the records.

As the tops of the air-inducing pipes in the Taylor compressor stand above the water-level in the intake, their obstruction by floating debris seems probable. At the same time, an examination of the Frizell design suggests the possibility at least of blocks of ice or floating logs lodging in the air-chamber, whence their removal would be impossible without shutting off the water, and pumping out the underground portions of the plant.

Leaving aside the obvious superior simplicity of the hopper, and considering only the relative effectiveness of the two designs, the following foot-note from 'Compressed Air Plant' by R. Peele deserves insertion.

"Since the Victoria plant was put in operation, trouble has been experienced by the freezing up of the small pipes of the intake-heads, due to the severe winter climate of the region. This has led to the removal of the heads, as originally designed, the water being allowed simply to flow into the top of the compressing pipes. I am informed that the capacity of the plant, in cubic feet of free air compressed per minute, is practically the same as when the intake heads were in use."

This seems to show that the particular arrangement of the air-intake has no controlling influence on the practical efficiency of the plant. But the statement emphasizes, in a still more decisive manner, the simplicity of that system of air-compression. It may certainly be contended that in mountainous regions, compressed air may often be produced at a moderate cost of first installation and that the operating expenses would be, in not a few cases, practically negligible.

A self-suggested objection lies in the cost of sinking a shaft of sufficient depth to secure a convenient air-pressure, as such a shaft must be of substantial construction to insure permanency. This objection would doubtless be well founded in some instances; yet it might frequently be overcome by having all the parts of the plant laid upon or built at the surface.

Fig. 3 illustrates the case of a ditch or flume running along the slope of a mountain. This is dammed at A and the water is led by the pipe AB to the air-receiver B. This might be built above ground of reinforced concrete, or else, be excavated, lagged and cemented to make it air-tight. The use of pressure-tunnels in hydro-electric plants shows that such construction may be both inexpensive and substantial. The water returns through another pipe BE to a point E located at the proper vertical distance below A to secure the desired power. The same water is then returned to the ditch at F, the section of the tail-race EF being, of course, larger than of AF. All of the water is available for other uses below the position of the compressor. The portion AF might be omitted altogether and replaced by a short diversion-canal AE, to be used if it is desired to dispense with the compressor.

Similar plants could be established along a stream, either for operating machine-drills in a mine or tunnel, for pumping water to a point above the level of the ditch, or for still other purposes. Their design would obviously be governed by local conditions. For instance, the topography might not permit the extension of the pressure-pipes far enough downward for raising the air to a sufficient working-pressure. In such a case, the air might be delivered at a lower pressure, and conveyed to a piston-compressor, the hydraulic portion of the plant acting as the first stage in compound work, and permitting the use of a smaller machine to complete the compression.

In the case of a certain California mine, the total available head was such that the water-wheels operating the

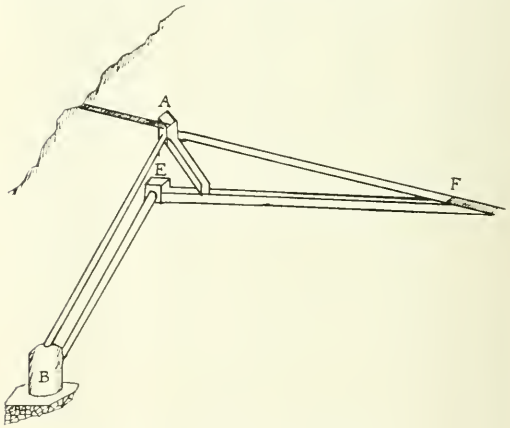


Fig. 3. Sketch of typical hillside plant.

hoist and the air-compressors are about 130 ft. above the river. Under these conditions, the tail-water of the wheels, which was going to waste, at a moderate cost could have been utilized to develop a considerable amount of compressed air. This air could have been used either to dispense with one half of the duplex machine in use at the shaft, or to operate an air-lift pump. As it was the pump frequently required so much air as to reduce materially the amount available for the machine-drills.

Like other processes apparently simple in principle, the hydraulic-compressor requires careful study in its practical design, in order to attain efficiency in the coördination of the various parts. The detailed treatment of a concrete case would, perhaps, prove a rather arid peroration to this paper, but its general lines may briefly be presented. The action of this machine is based upon the downward motion of a column formed of a mixture of air and water, against the back pressure of an ascending column of water alone. It may, therefore, be considered as the counterpart of an air-lift, inasmuch as the excess in weight of the descending column over the back pressure must be sufficient to cause the entrainment of

the proper amount of air, and to overcome the other elements of resistance.

The analytic theory of the motion of air in contact with flowing water is far from simple, it involves among other factors, the shape of the air and water ajutages. The degree of certainty of its conclusions would not, in the present case, compensate for its abstruseness. The adjustment of the water and air supplies must remain facultative, whether or not, as contended by Mr. Frizell, that adjustment is invariably automatic.

Starting from the conclusion of his experiments, that fine air-bubbles rise in the water at an approximate velocity of nine inches per second, the velocity varying as the square of their diameter, it is evident that water must enter the induction pipe at a speed materially greater than that figure, the more so, as all available records of tests on entrainment devices point to a low efficiency. Furthermore, the necessary velocity, and consequent loss of head, will be reduced by subdividing the entering air into minute bubbles, as done in the Taylor compressor.

Experience has set some practical values of the proper velocity, which is said to be from 12 to 16 ft. per second.*

The first step, in designing such a machine, is to assume a definite value for that velocity, for instance, 14 ft. The weight of the column of water to produce that velocity is 190 lb. per sq. ft., but it may be taken as 250 lb. to cover frictional and other losses.

If R is the volumetric ratio of free air to water at the head of the induction pipe, d the weight of one cubic foot of free air, P_0 the atmospheric pressure, and P_1 the absolute receiver pressure desired, both in pounds per square foot, the weight of one cubic foot of mixed air and water is:

At the top of the induction pipe: $\frac{62.4 + dR}{1 + R}$

At the bottom of the induction pipe:

$$\frac{62.4 + dR}{1 + R\,\frac{(P_0)}{(P_1)}}$$

Giving an average value:

$$\frac{62.4 + dR}{2}\left[\frac{1}{1 + R} + \frac{1}{1 + R\,\frac{(P_0)}{(P_1)}}\right] = m$$

If we assume H to be the height of the induction pipe and h that of the pressure pipe; we may write, as a first conditional equation:

$$mH = 62.4\ h + 250 \quad (1)$$

E being the efficiency of the process, and the compression being isothermal, another relation, when c = cubic feet of water and v_0 cubic feet of free air per minute is:

$$62.4\ cE\ (H - h) = P_0\ V_0\ \mathrm{Log_e}\ \frac{(P_1)}{(P_0)} = P_0\ R_c\ \mathrm{Log_e}\ \frac{(P_1)}{(P_0)} \quad (2)$$

But

$$P_1 - P_0 = 62.4h$$

so that at sea-level, for instance, equation (2) becomes:

$$0.0295\ E\ (H - h) = R\ \mathrm{Log_e}\ (1 + 0.0295\ h) \quad (3)$$

*Gibson's 'Hydraulics and Its Application.'

The air-pressure is a known quantity, and so is the working-head (H-h) so that E and R may be determined from equations (1) and (3).

This will give a first idea of the combination of the assumed numerical values, but a more accurate estimate of the detailed elements is, of course, necessary for different velocities in the induction pipe; the separation of air from water is the most important contributory factor of the efficiency, as the proportion of air passing to the tail-race either in suspension or in solution, affects the back pressure. It hardly need be said that aside from the computable data, the practical results of existing installations have to be taken into careful consideration.

The dominant feature of the hydraulic process is a considerable reduction in operating and maintenance expenses as compared with mechanical installations. For great capacities and high air-pressures, the first cost might reach large figures yet would compare favorably with that of a regular power-plant of the usual types, while the obtainable efficiency is decidedly higher. For small mines or tunnels, remote from manufacturing centres and difficult of access, the system should prove valuable in many cases.

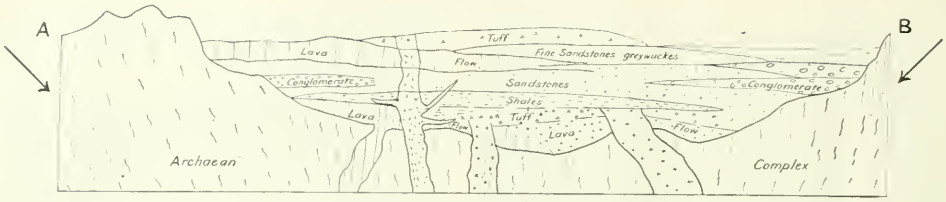
A Location Notice

Our contemporary the *Contact Miner*, of Nevada, publishes the text of a location notice found on the Granite range. It was dated June 11, 1889 and was found on ground that bore no evidence of ore. It is in poetic diction, but, for fear of shocking our readers, we give it in prose form.

"We, the undersigned men of worth, just to show we are on the turf, do hereby locate for ourselves alone, 1500 feet radius around this stone, together with mineral and water rights, all placer lands and townsites. We claim all ledges and veins within our lines, of brass, gold and other mines, and all coal and oil as well, from the top of sagebrush down to hell, and all the air and sunshine, too, up to where the sky shines blue."

Protective paints upon metal that is to be embedded in concrete structures, in order to prevent any damage that might be caused by electrolysis, has been proposed. No tests have been made that have determined what type of coating is best suited for the purpose. It would appear from first consideration that a paint capable of forming a film of high electrical resistance would be most efficient. Such films, however, generally present a high gloss surface and are apt to prevent the proper bonding of the concrete with the painted metal, thus doing more harm than good. It is chiefly for this reason that engineers have not generally adopted the use of paint upon reinforcing metal.

Fuller's earth production of the United States in 1914 amounted to 40,981 tons worth $403,646, an increase of 2387 tons. There were fourteen producers.



Section showing probable origin of older rocks of Kalgoorlie region (now represented by older greenstones, calc-schists, sheared conglomerates etc) before they were folded and intruded by the Igneous Complex shown in Plate II.

FIG. 1.

The Geology of Kalgoorlie

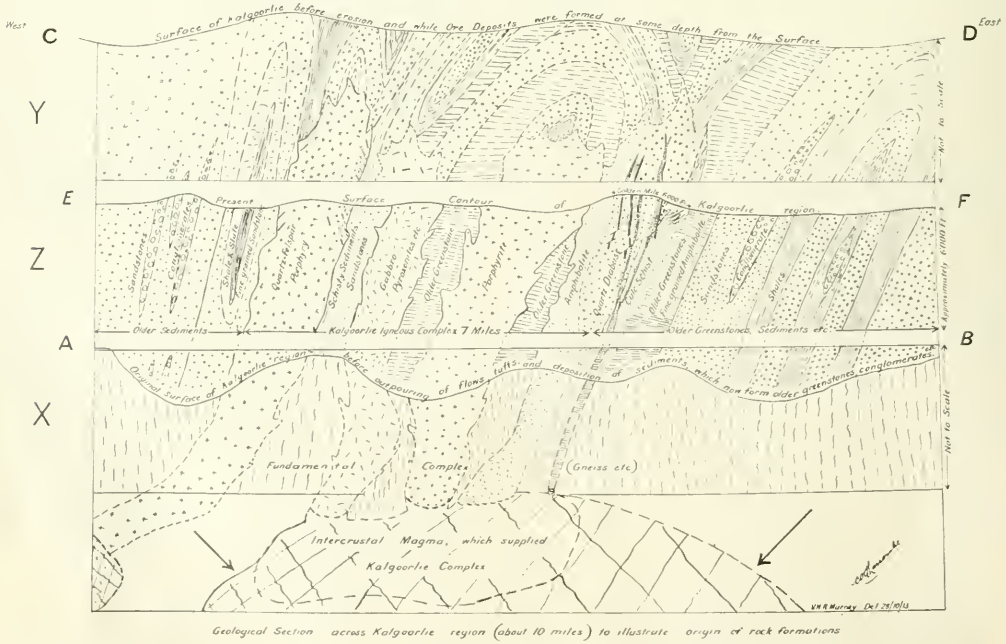
By C. O. G. LARCOMBE

THE SLATEY STRUCTURE. The so-called 'slates' have been described in some detail in my book on the geology of Kalgoorlie, but since the publication of that work I have carried out many observations with a view to determining their economic effect on the lodes, and their mode of occurrence.

I am now certain that on the Golden Mile the carbonaceous 'slate' has three modes of origin: (1) from the quartz-dolerite, (2) from the felsite (albite-porphyry), and (3) from the calc-schist.

In each case the slate is formed along lines of maximum shearing. From its general appearance one would be inclined to think that carbon was the chief constituent, but as a matter of fact the slatey structure marks a silicified zone. As a rule the structure is that of a cleat or joint of carbon not much thicker than a quarter of an inch, surrounded by cherty quartz passing outward into sheeted aphanite zones, though in places the cleavage does not completely obliterate the character of the original quartz-dolerite.

The plan of the 2630-ft. level of the Golden Horse-Shoe mine clearly shows the distribution of the slatey structure in felsite and quartz-dolerite respectively. I have not had much experience with the 'slate' in calc-



Geological Section across Kalgoorlie region (about 10 miles) to illustrate origin of rock formations

FIG. 2.

schist, but the slatey parts of the quartz-dolerite and felsite vary in strike and dip. They may be less than an inch in length, or they may be dozens—even hundreds—of feet. The more persistent bands strike north 40° to 45° west and dip between 65° and 75° in a westerly direction.

Relation to Lodes. It seems quite clear that the slatey structure in both quartz-dolerite and felsite was caused before the lodes were formed. There are many diverse opinions as to the effect of the 'slate' bands on the lodes. Since these are older than the lodes, the question is often asked: why do we not get rich ore with the carbon? As already stated, the actual amount of carbon is small, often no thicker than a sheet of paper, while the slatey bands are composed essentially of cherty silica, thus forming powerful silicified zones.

In the very highly altered zones, where there has been much differential movement and consequent change in strike and irregular distribution of the slatey silicified bands, it would appear as if the shear-line controlling the lodes must weaken. This caused the solutions to scatter, the 'slate' zones forming impenetrable barriers, with a consequent reduction, if not absence, of the precious metals.

The felsite 'slate' seems to me to be the worst in this respect.

But the more continuous bands of slatiness in the quartz-dolerite, such for instance as that on the 2480-ft. level of the Golden Horse-Shoe have no detrimental effect; in fact, in this case the 'slate' has acted as a barrier against which the solutions were allowed to concentrate. At this particular point one of the strongest enrichments was found. The occurrence may be seen in Fig. 3.

Origin of the Carbon. There has been much discussion as to the genesis of the carbon in these 'slates,' and the fact that the latter occur entirely within an igneous rock has tended to stimulate the controversy.

In a bore at the 1048-ft. level of the Associated Northern mine gas was given off containing 42.5 to 56.5% of methane.[1] Another report states:[2] "Carbonic acid gas is met with in some boreholes. One in the Lake View Consols has given off this gas for the past two years."

After closely investigating the question I am convinced that

1. The carbonaceous deposits are formed along shear-lines in the quartz-dolerite, felsite, and calc-schist.

2. In some cases the carbonaceous material is associated with quartz, pyrite, and ordinary gangue-minerals in open fissures, as in the main west cross-cut, 62 ft. from the main shaft at 2650 ft., in the Great Boulder mine.

3. In the first case the carbon is probably derived from solutions, possibly of oxides.

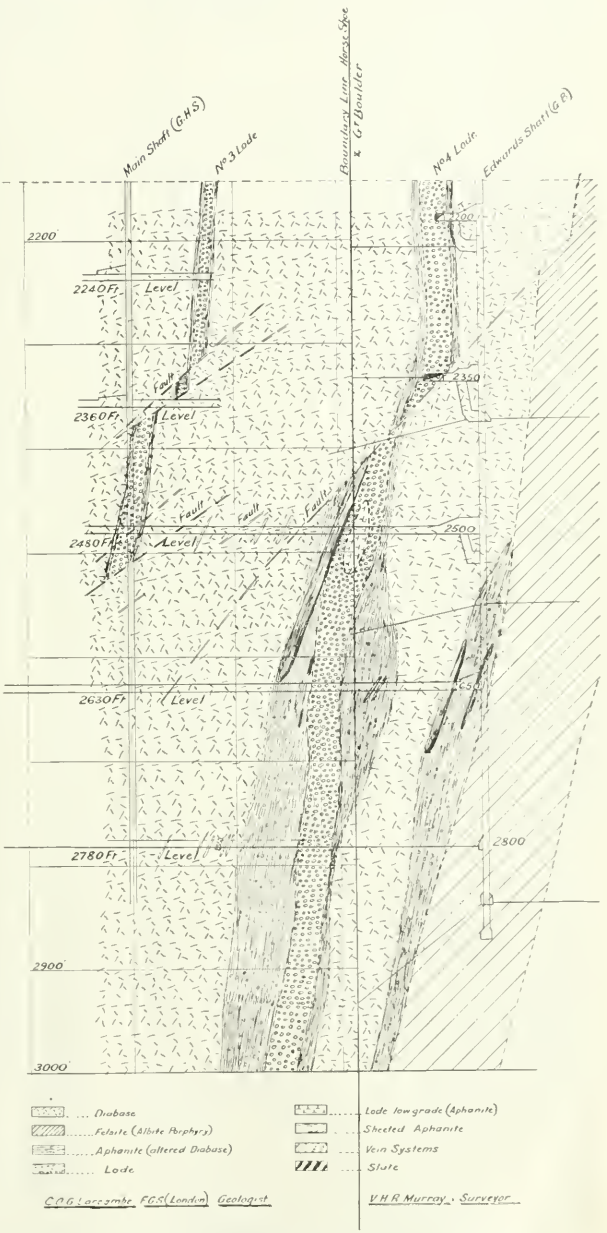


Fig. 3. Transverse Section, Golden Horse-Shoe.

[1] 'The Geology and Ore Deposits of Kalgoorlie,' Geol. Surv., W. A., p. 159.

[2] *Engineering and Mining Journal*, January 23, 1902, W. A. Prichard.

4. The mere fact that with the graphite veins are the same minerals that characterize the lodes and enclosing rock suggests a genetic connection between the veins and the metamorphic phenomena. In reality the quartz and other gangue-minerals represent contemporaneous crystallizations with the graphite.

Recent investigations in the graphite deposits of Ceylon and Dillon,[3] and the experiments of Van Hise, afford abundant support for my contention of origin from solutions. The constituents of the quartz-dolerite have crystallized at high temperatures from silicate solutions, and since the temperature of vaporization of graphite is known to be 3000°C., a temperature it is impossible to conceive the quartz-dolerite to have ever attained, the idea of sublimation from carbon vapors is scarcely tenable. We know that later chemical metamorphism generated much carbonate material, while there was much water shown by the phenomena of cementation at every level. Consequently the most feasible suggestion is that the graphite before deposition must have existed in the solutions in the form of some compound of carbon.

E. S. Simpson says: "In all these cases there would appear to be a direct connection between the gas and the graphitic schists, the gas being encountered either actually in such rocks or in fractured rocks close to, and in direct communication with them. This lends support to the theory held by the writer [Simpson] and apparently by A. Montgomery, State mining engineer, that the graphitic 'slates' found in lenticular masses in the heart of large areas of amphibolite and greenstone schists, at Kalgoorlie, Cue, Coolgardie, and elsewhere, are in reality shear-zones in the greenstone into which hydrocarbons of volcanic origin have penetrated, depositing finely divided carbon in them during slow combustion. This oxidation may have been at the expense of oxygen in the pores of the rock, or at the expense of ferric compounds capable of reduction to a lower state of oxidation."

This suggestion seems plausible, since hydrocarbons, especially methane, are found among the gaseous constituents of igneous rocks and in volcanic gases. But an argument against the above idea is that the carbon is so closely associated with vein-formation, which does not take place at high temperatures, whereas I can so far find no literature to show any reactions for the decomposition of hydrocarbons—with formation of graphite—below 500°C., the temperature expected under the conditions of vein-formation. It is therefore more likely that the methane is formed as an after-effect, for the graphites were powerfully slickensided after their formation, though some hydrocarbons may have been left undecomposed.

Weigert's[4] researches throw considerable light on the subject, for he has proved the reversible reactions:

$$C + 2H_2O \leftrightarrows CO_2 + 2H_2$$
$$2C + 2H_2O \leftrightarrows 2CO + 2H_2$$

and also that below 500°C. the CO_2 and H produced tend to react to make water and graphite.

In view of these facts it is only reasonable to expect graphite deposits along shear-lines at great depth, where the gases cannot escape.

In the case of Kalgoorlie, I strongly incline to the opinion that the formation of the carbon is due to the de-oxidation of carbon oxides that existed in the vein-solutions and along the sheared lines.

THE FELSITE or albite-porphyry has recently come into prominence on account of its somewhat large development in the Ivanhoe mine, and the recommendation of Dr. Malcolm Maclaren to sink the main shaft on that property to 3470 ft. and then cross-cut with the hope of picking up the lode on the foot-wall side of the felsite dike.

In various parts of the district this dike possesses a most characteristic pink color, but at deep levels it is a compact pale greenish rock, in many cases practically indistinguishable from the aphanite or altered quartz-dolerite. Moreover, both felsite and aphanite carry slatey bands that increase the alteration and thereby render separation almost impossible. It was for this reason I did not attempt to separate the felsite from aphanite in my original work, and only two dikes were recorded at deep levels. These were positively identified in a bore put out in an easterly direction from the 2350-ft. level from the main shaft in the Great Boulder mine.

But for economic reasons I have carefully investigated the question. I realized that if Dr. Maclaren's remarks held good as regards the Ivanhoe mine there would shortly be trouble in the Horse-Shoe ground, and the manager of the latter kindly allowed me to make a close investigation of his property.

Dr. Maclaren says: "The Ivanhoe east lode enters the porphyry (that is, the felsite) at 2800 ft. on the southern boundary," or, in other words, the northern boundary of the Horse-Shoe. I have proved that the foot-wall of the felsite at this depth is in the main shaft of the Great Boulder or a few feet to the east.

Judging from these remarks, and the calculated position of the Ivanhoe east lode at this depth, the felsite on the northern boundary of the Horse-Shoe would be certainly not less than 350 ft. wide, and possibly more. I know the felsite continues at least 2000 ft. north of this point. Consequently such a powerful body as this would surely go through the Horse-Shoe ground, with detrimental influence on that property. But after examining about 200 rock-sections from the Golden Horse-Shoe and Great Boulder properties, I am convinced that much of the so-called porphyry (felsite) is aphanite or altered quartz-dolerite. Moreover, the felsite has a dip of 73° and a strike of N.44°W. between the 1500 and 2800-ft. levels. If this dip is continuous, and if we take the foot-wall of the felsite as being 20 ft. east of the Great Boulder main shaft at 2800 ft., then the maximum thickness

[3]"A Theory for the Origin of Graphite as Exemplified in the Graphite Deposit near Dillon, Montana," A. N. Winchell, *Economic Geology*, Vol. VI, No. 3, 1911, p. 218.

[4]Abegg's Handb. Anorg. Chem., III, 2, 1909, p. 196.

of the felsite would be about 250 ft., a fact confirmed by the Ivanhoe bore put out from the 2870-ft. level. But I doubt if the actual felsite is as much as 250 ft. wide (Dr. Maclaren says 340 ft.), a fact of much importance to the Ivanhoe mine, for in the latter case the lode will enter the quartz-dolerite (beneath the felsite) at a less depth than anticipated. The 2800-ft. level of the Horse-Shoe mine shows the possible western edge or hanging wall of the felsite, which is no doubt considerably different from that of Dr. Maclaren. Fig. 4 shows the position of the felsite dike at 1650 ft. between the Hamilton and Edwards shafts. I have prepared Fig. 5 to show the possible position of the felsite from the surface to 3300 ft. between the Edwards and Horse-Shoe main shaft.

Dr. Maclaren says: "I have, however, gained the impression that the dike will flatten, and it will not persist as steeply as might be inferred from the last observed dip," but I have seen nothing in my examination outside of the Ivanhoe mine to support this idea of flattening. Furthermore, as far as one can judge, the boring in the Ivanhoe does not appear to have confirmed it as shown in Fig. 6, which I have prepared from informa-

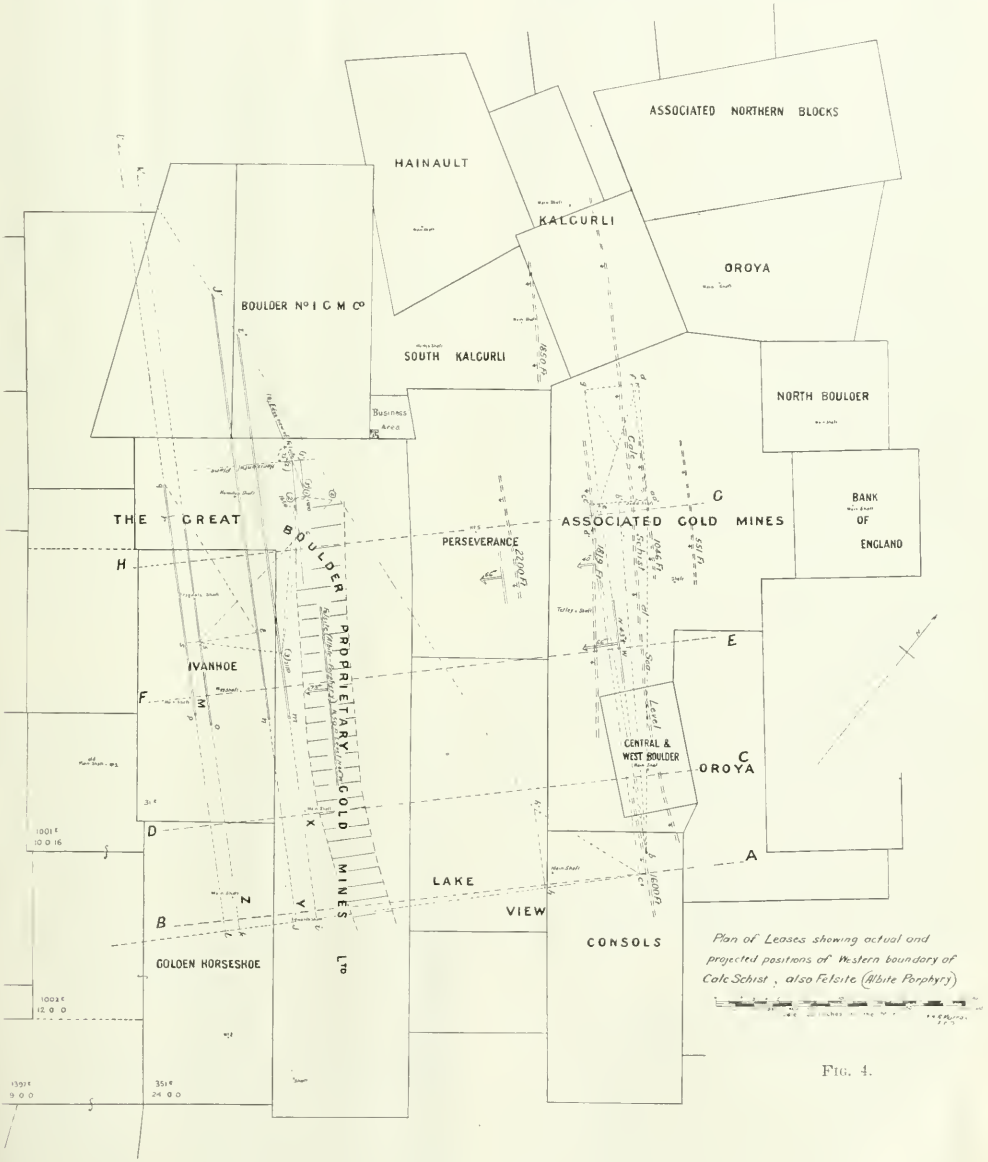


Fig. 4.

tion culled from reports, to endeavor to show the possible conditions revealed by the Ivanhoe bore put out at an angle of 39°30′ from 2870 ft. The dotted lines represent the position of the felsite as anticipated by me. In fact, at the southern end, opposite Edwards shaft, I am inclined to think the dip of the felsite at 2800 ft. is greater than 73°: this is indicated by the cross-section of the Great Boulder, which Mr. Hamilton kindly allowed me to examine.

Relation of Felsite to Lodes. It is quite clear that the felsite is older than the lodes. The shearing forces that produced the slatey bands in the felsite and quartz-dolerite, respectively, are also prior to the formation of the lodes; consequently, the felsite 'slate' is older than the lodes.

My experience has been that although the lodes pass into the felsite their gold-contents are either low or erratic and patchy. This is particularly the case where lodes enter slatey zones, especially when such zones make an acute angle with the lodes. The 'slates,' being very highly silicified and cherty zones, cause the main-lode shear-lines to split to a certain extent, thus causing an unequal and wide distribution of ore-bearing solutions and consequent erratic distribution of ore. Apart from this fact altogether, the felsite is inherently a tougher rock than the quartz-dolerite and is more resistant to the forces of shearing. In addition, it does not appear to me to offer the same inducements to replacement as the quartz-dolerite. The felsite therefore cannot be looked upon as a kindly rock for ore-formation, but it is of the highest importance to realize that the lodes do live in the felsite, and I agree with Dr. Maclaren this far, that if the shear-zones are able to withstand the resistance offered by the felsite over 700 to 900 ft. (on account of its steep dip) there is no geological reason why ore should not make again on the foot-wall side of the felsite. But with my knowledge it would be rash to predict any possible ore at such a depth, more particularly as there is a tendency for epidote to develop in the quartz-dolerite in depth.

The question is frequently asked: Why does not the Boulder get ore on the foot-wall side of the felsite. So far it has not, but this cannot be used as an argument in the case of the Ivanhoe, because the Great Boulder management has not followed the lode through the felsite.

The calc-schist has been the cause of considerable discussion of late, owing to the following statement by Dr. Maclaren in his report on the Kalgurli mine.

"Five other important mines (besides the Kalgurli) have suffered in the same way, together with several smaller mines. The experience of all these is identical, namely, that beyond a certain short distance (generally less than 100 ft.) beneath the quartz-dolerite, lode-channels fail to carry ore."

As far back as 1910 I penned the following remarks: "Another point is that, as shown in the general section across the field (Fig. 2) the metamorphic tuff (calc-schist) tends to dip to the west, and the position of this rock at various levels should also be marked, for, if lodes pass into the metamorphic tuff (calc-schist) their continuance will be doubtful. On the other hand, the contact of the metamorphic tuff (calc-schist) with the quartz-andesite (quartz-dolerite) might perhaps be regarded as a favorable zone for the occurrence of ore."

C. Gibson, in his report to the Geological Survey, says: "In economic importance the calc-schists probably rank next to the quartz-diabase (quartz-dolerite), many auriferous deposits of considerable importance occurring within them; these, however, have so far been at no great distance from the newer intrusives." He says further:

"No quartzose orebodies occur in this series of rocks, the lodes being similar and behaving similarly in every way to the schistose and carbonated ores found in the diabase, and the same general remarks apply equally well to both. As a general rule, however, they are more patchy in their contents and on the whole of lower grade than the latter class of deposits."

During last year I carefully examined the western margin or hanging wall of the calc-schist with a view to determining its position in various parts of the district. In order that the actual conditions may be more clearly grasped, I have prepared the plan (Fig. 4).

The plan shows the western edge of the calc-schist at 551 ft., 1046 ft. above sea-level, and 1819 ft. in the Associated mine; at sea-level and 1850 ft. in the Kalgurli mine; 1600 ft. in the Lake View Consols, and 2200 ft. in the Perseverance mine.

For the projections three points were taken:

Point.	Depth.	Mine.
a	1046	Associated
b	1600	Lake View Consols
c	1819	Associated

By projecting on to *ab*, the line *gcb* was found to be the strike N.43°5′W. From the projection to the left of *ac* the dip was found to be 66°. Consequently, down to the 1819-ft. level of the Associated, the dip of the hanging wall of the calc-schist is about 66°. A second construction (not shown on plan) gave a dip of about 40°, after a depth of 1750 ft. But how far west this lower angle of dip is to be continued nobody knows. I projected the point *c* to *c″*, and by drawing the horizontal line *c″l* the depths to which the Great Boulder Edwards, Horse-Shoe, and Ivanhoe shafts must be sunk below their present bottoms to meet the calc-schist can be worked out, as the plan shows, namely, by projecting a line through the shafts mentioned on to the horizontal line *c″l*, measuring off *im*, *jn*, etc. (the difference between the depth of the point *c* and the bottoms of the respective shafts) and measuring off the distances left, namely, *mi′*, *nj′*, etc. On the other hand, *c″h* represents the horizontal distance over which I think the calc-schist continues at a dip of about 40°. I then carried the dip back to 66° *h′l′*. That this construction is possibly near the mark is shown by the fact that no calc-schist occurs in the bore put out 300 ft. east from the main shaft of the Great Boulder at 2800 ft., while the bore east from the Ivanhoe shaft at 2870 ft. is still in quartz dolerite

(Fig. 6). The latter bore was carried a distance of 712 ft. into the Great Boulder ground at an angle of 39°30′.

From these data the calc-schist should be cut in the shafts mentioned at or about the following depths:

	Feet.
Main shaft, Great Boulder	4803
Edwards shaft, Great Boulder	5046
Horse-Shoe main shaft	5750
Ivanhoe main shaft	6019

It is hoped that these deductions will turn out to be correct, for when we come to consider that the quartz-dolerite forced its way up the western limb of an isocline in the calc-schist there seems to be every justification for continuing the dip of 66° after a horizontal heave of 500 ft., especially in view of the evidence afforded by the bores just mentioned.

From the foregoing remarks it is clear that there is a similarity of opinion between Dr. Maclaren and myself as to the general behavior of this rock, but I am inclined to take a distinctly more optimistic view for the following reasons:

1. From figures kindly supplied by the Chamber of Mines, I find that the calc-schist has yielded gold to the value of close on £7,000,000, and a rock that can yield so much gold above a vertical depth of 1200 ft. should not be neglected.

2. The Eclipse mine is entirely in calc-schist.

3. The foot-wall of the Oroya ore-shoot in the Associated Northern ground at the No. 5 level is 200 ft. from the quartz-dolerite contact. This leaves a fair margin.

4. The Perseverance mine has ore in the calc-schist.

5. The change in dip of the calc-schist at 1750 ft. is probably due to an old fault. This may afford possibilities.

6. Ore has been found in the calc-schist down to 2200 feet.

On page 117 in my book I said: "The ore-occurrences on the eastern side of the Golden Mile are quite unique, and differ altogether from the lode formations that dominate on the western side of the field. The country-rock on the east is also different from that on the west.

"The bulk of the ore is derived from orebodies along large fault-planes, and zones of impregnation at the junction of faults. It is to this class that the famous shoot of ore which commences in the Brown Hill, passing through the Associated Northern, Oroya, and finally the Associated mine, belongs." On page 127 I further remark:

"There seems to be much more geological work required on the eastern side of the field, to prove not only the direction of fault-planes likely to carry ore, between the two dominant outer planes, but also the possibility of parallel fissures."

Finally, on page 287, I remarked: "It is hard to believe in country like that on the eastern side of the field, where the ore grows on three large fault-planes, there should not be more faults of a similar nature."

Of course, when it comes to a question of deep sinking in the calc-schist I fear I cannot recommend it, for the trouble is that this rock apparently passes downward

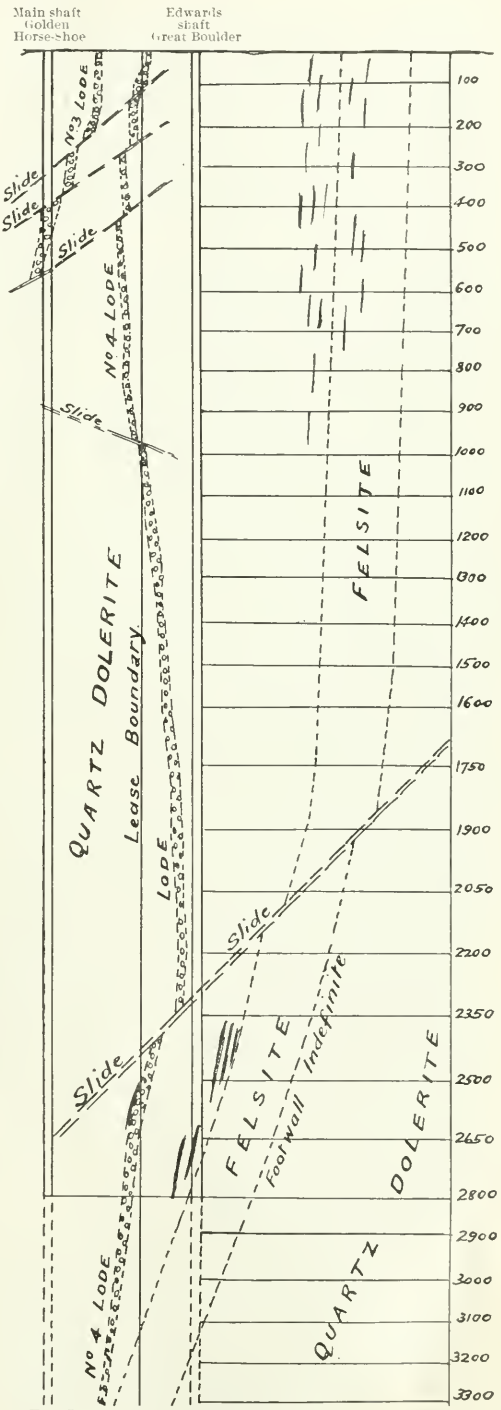


FIG. 5. TRANSVERSE SECTION OF GOLDEN HORSE-SHOE AND GREAT BOULDER.

into fine-grained amphibolite, which we have no reason to believe contains auriferous deposits; and below this we have the barren sediments as shown in my cross-section of the field (Fig. 1 and 2).

However, as shown in cross-sections, it is clear that the life of the western mines is not affected by the calc-schist, for, although at 1750 ft. the calc-schist flattens to angles as low as 36°, I am of opinion that it will return to its normal dip and so not come into the western mines much before 5000 feet.

However, I am still hopeful that new orebodies may yet be found in the calc-schist, for I see no reason why they should not if the necessary fault-planes or sheared-lines exist, and I think the recent developments in the Oroya Link leases at depths not far short of 1000 ft. strongly support this contention.

The Quartz-Dolerite. So much has been written about this rock by Dr. Maclaren,[5] Geological Survey,[6] and myself[7] that there is little to be said in the way of description.

But my recent investigations have brought to light certain economic phases in the development of the rock that have a bearing upon the economic feature. First, there is a very basic variety containing much epidote developed along the eastern edge of the quartz-dolerite in the Perseverance mine on the 1900-ft. level. Although it is believed that the epidote-bearing variety, which passes into epidote-amphibolite (epidiorite) is not a favorable sign, my examination showed that in this instance the differentiation is only local, for the normal type is again present on the 2200-ft. level.

An interesting rock, which undoubtedly belongs to the Boulder type, was examined from a bore 600 ft. deep, put down on the southern end of Lease 4236E east of the Brown Hill townsite. No quartz-dolerite is shown at this point on the Geological Survey map, and the particular rock described, which is east of the calc-schist, evidently belongs to the Brown Hill branch mentioned by Dr. Maclaren. It is regrettable that no lodes have yet been reported in this rock. Another point is that a certain amount of epidote develops in the dolerite at depths of 2800 ft. on the western side of the district, and it is important to watch the influence that this change is going to have on the lodes in depth.

General. For the information of those unacquainted with the geological structure of Kalgoorlie, I have drawn cross-sections (Fig. 1 and 2) over 10 miles of country, in order to show the probable relationship existing between the various rock formations.

From these cross-sections it will at once be seen that after all the Golden Mile, the local name for the gold-bearing area from which most of the gold has been won, forms only a small part of the entire width—about 6000 ft.—characterized by the intrusion of quartz-diabase (quartz-dolerite) with the associated calc-schist and felsite (albite-porphyry).

[5]Mining and Scientific Press, August 2, 1913, pp. 189-90.
[6]"Geology of Kalgoorlie," pp. 56-65.
[7]"The Geology and Ore Deposits of Kalgoorlie," pp. 22-30.

If we go far enough back into the geological history of Kalgoorlie, long before any ore deposits were formed, the conditions would be something like those shown in Fig. 1. Here we have a fundamental platform, marked Archean Complex (Dr. Maclaren's Sub-Kalgoorlie formation) on which was deposited a series of alternating lava-flows, ash-beds, sandstones, conglomerates, etc. As a result of the gradual cooling of the earth the crust continued to contract on a shrinking nucleus, and was in consequence subjected to enormous strains and stresses, which resulted in the folding of the lava-flows, etc., in the same way as a sheet of paper is crumpled under lateral compression, the amount of compression being just sufficient to cause the limbs of the folds to be almost parallel (isoclines), but with a steep dip westward.

During the process of folding, the original rocks were changed as follows:

Original rock.	Now represented by
1. Lava-flows	Older greenstones.
2. Tuffs or ash-beds	Calc-schists (though these are in some cases more likely the altered edge of the older greenstones).
3. Conglomerates	Sheared conglomerates.
4. Sandstones	Hardened sandstones and micaceous quartzites.
5. Shales	Hardened shales, slatey rocks, and micaceous schists.

Up to this time, before any intrusions forced their way to surface, the Kalgoorlie terrain consisted of the altered representatives of the older rocks, and the surface of Kalgoorlie was no doubt much higher than it is now, but still probably of the nature of a tableland, and represented by the line *C D* in Fig. 2.

In those days, as at the present time, there existed great reservoirs of molten rock furnishing material, not only for the various intrusive rocks—granite, gabbro, etc.—of the earth's crust, but also the great flows of lava that from time to time have been poured out over the surface of the land.

Some such reservoir as this is shown at the bottom of the drawing. From this magma the various igneous masses that are characteristic of the Kalgoorlie region were no doubt derived by the ordinary processes of differentiation. The chief rocks that separated out from the magma were gabbros, pyroxenites, quartz-dolerite, porphyrite, and felsite (albite-porphyry) but farther south of the section peridotites appear.

The actual order of separation does not cut much figure from an economic point of view, but we know that the quartz-dolerite and felsite are the intimate associates of the gold, and at least that the felsite dikes were the last product to separate, for they forced themselves through both calc-schist and quartz-dolerite.

The quartz-feldspar-porphyry at Binduli, on the left side of the section, has been referred to as a separate magma in the direction of Coolgardie.

It seems quite feasible to suggest that the forces that folded the older rocks acted on the intercrustal magma, and so caused the igneous masses to be forced toward the surface along the limbs of the isoclinal folds, as we

know was the case with the quartz-dolerite, which came up from the west at an angle of about 66° along the western edge of the older greenstone, in part converting the edge of the latter into calc-schist.

During the period of these intrusions the surface of Kalgoorlie was much higher than it is now (see *C D* in Fig. 2), and the tops of the intrusions were some distance beneath the surface.

Crustal forces must have still been in evidence, for up to this time no ore deposits had developed, so that sheared lines were later formed in the quartz-dolerite and felsite (for both rocks are older than the lodes). It was along these sheared lines that the process of ore deposition continued to operate with the ultimate production of rich lodes. As yet the surface of Kalgoorlie was still represented by the line *C D*, and it was not until ages of erosion, when the surface was worn away to *E E* that the lodes were exposed.

In concluding this paper I must express my sincere thanks to the various managers in the district, especially J. W. Sutherland, general manager at the Golden Horse-Shoe mine, for kindly allowing me to use the plans prepared in connection with my report on this mine. I also owe much to V. H. R. Murray for the great care he has taken in the production of the various plans and sections, as well as F. W. Rowe, who made the microscopic sections upon which my conclusions have been based.

[Publication of this interesting article by the Lecturer on Geology in the Kalgoorlie School of Mines has been delayed. The following notes bring development up to the end of May 1915: At the Ivanhoe the main shaft is down to 3345 ft. from the surface, in country assaying a trace of gold. A cross-cut eastward has been started from the shaft at 3320 ft. At the end of 1914, a diamond-drill completed a hole from 3170 ft., going east at 38° to explore the porphyry dike, which was cut at a vertical depth of 3297 ft., and 184 ft. east of the shaft. It continued to 409 ft. east, equal to a depth of 3475 ft. At 262 ft. 6 in. the hole passed through 33 in. of material assaying a trace. This is the East lode, and is 32 ft. farther west than at 3067 ft. The porphyry is 31 ft. farther west. Nothing of interest was disclosed by the hole. Reserves of ore are estimated at 998,718 tons worth $8.94 per ton. At the Horse-Shoe mine the main shaft is down 3068 ft. A cross-cut is being driven east. The mine is estimated to contain 727,043 tons of $8.56 ore, of which 82,416 tons, averaging $15.30, is in No. 4 lode, which is near the boundary of the Horse-Shoe and Great Boulder properties. This lode at 2900 ft. in the Horse-Shoe has averaged 10 ft. in width as far as opened, worth up to $32.40 per ton. The south drift is in 182 ft. The Horse-Shoe made a profit of $43,500 in June. Ore reserves in the Great Boulder are estimated as 469,115 tons, assaying $15.14 per ton. No sinking has been done for about four years, or since the boundary lode passed into the Horse-Shoe ground.—Editor.]

Compound interest causes a sum of money to double in a period of years that is approximately 69 divided by the rate per annum: thus, if the rate is 3% the sum will double in 23 years. A French mathematician has calculated the value of a franc put at compound interest 2000 years ago and finds it to be equivalent to 162,260 spheres of pure gold the size of the earth; hence, a dollar, under the same conditions, would have grown to equal more than 800,000 golden worlds.

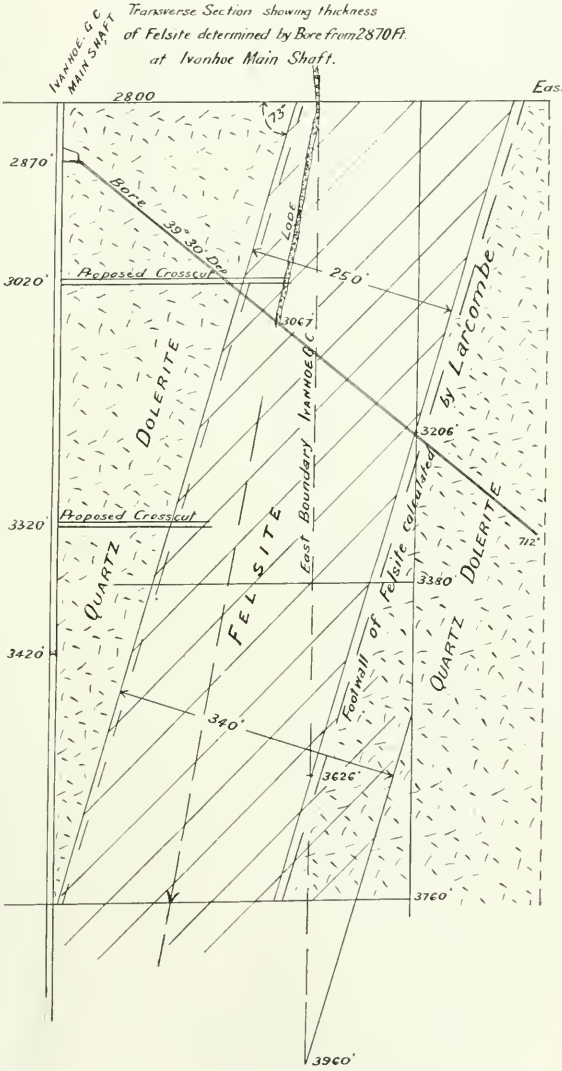


Fig. 6.

Mining in Arizona

By CHARLES F. WILLIS*

Miners, business men, and residents generally are happy over the prosperity that now pervades the State. Never were wages so high, never was the copper market in better shape, and never were the activities of the mining centres in more expansive mood. Conditions from a mining standpoint could hardly be better; all properties are working to capacity, and even with an overload; working forces are being increased wherever room can be made available. Although the price of copper has declined slightly during the month, it has not affected the increasing output of the mines of the State.

Among the events of the past month has been the revival of several old districts. The American Smelting & Refining Co. has started in this State with holdings in the Christmas and the Twin Buttes districts, and is now about to sink a few test churn-drill holes in the Silver Bell district, on the property formerly owned by the Imperial Copper Co., which was controlled by the Development Company of America and was a heavy producer up to 1909. In 1907 it yielded over 4,000,000 lb. of copper and 48,000 oz. silver. In 1908 almost 6,000,000 lb. copper and 68,000 oz. silver were produced. Then, with the blowing in of the Sasco smelter and the completion of the Arizona Southern Railway in 1909, about 15,000,000 lb. copper was produced. Litigation, terminating in a bankruptcy sale, brought the work to a close in the spring of 1915. Although it is not known who the purchasers really are, it is significant that shortly afterward the American Smelting & Refining Co. sent some churn-drills and started a systematic prospecting of the property. With the operations of the Copper Queen Consolidated in the Catalinas, the Cahmet & Arizona at Ajo, and the A. S. & R. at Silver Bell, it looks as though Pima county would come back to its old-time mining prosperity. The activity of these operators in Pima county has stimulated interest and caused others to start operations. L. D. Plankey and associates of Butte, Montana, have taken an option on the property adjoining the new holdings of the A. S. & R. in the Twin Buttes district and have purchased a diamond-drill for immediate prospecting.

The building of the railroad to the Magma mine in the Superior district is a reminder of the time when the famous Silver King mine made several millions of dollars in profit—from 1884 to 1886. The pinching of the orebody in 1887 caused the desertion of this once flourishing camp. On the Magma vein about 95,000 tons of copper ore has been developed, carrying 7.6% copper, 8.1 oz. silver, and 56 cents in gold. Reserves are rapidly increasing with the extension of the 1000-ft. level.

Another old producer has been revived at the property of the Kay Copper Co. in Black canyon. Although the main shaft has a depth of only 325 ft., the drifts and other exploratory workings are reported to show attractive conditions. Considerable quantities of ore have been shipped from this property in past years.

The Congress district is again active, but in a way different from heretofore. This district attracted attention in former years on account of the richness and persistence of the Congress lode. Much excitement was caused in the early days by the finding of considerable quantities of native gold on the tops of the hills. Although for many years these deposits furnished ground for 'dry-washing,' the persistent work of Messrs. Genung and Barnum in tracing the source of these dry placers has led to the uncovering of the old topography and the discovery of the ancient channel. Three hundred linear feet of exploration on this 'deep lead' has demonstrated that it is the source of the 'nuggets.'

The Phelps-Dodge Co. has invaded Mohave county and has optioned almost all the valuable claims in the Mineral Park basin. But little work has been done in this area, and even that in a rather perfunctory and haphazard manner, but considerable quantities of low-grade copper ore with occasional very rich ore have been uncovered in the surface-work. It is evidently the intention of the Phelps Dodge Co. to explore this basin by drilling.

The Harqua Hala is again coming into its own. Crosscuts run on the sixth level of the famous producer have encountered ore in both directions. Driving and raising on the orebodies are now in progress. This is virgin territory and both veins are of good milling grade. The Harqua Hala has produced more than $4,000,000 in gold in the past and bids fair to produce as many millions more. When it is considered that a vertical depth of only 200 ft. has been attained on this property, its production is little short of marvelous.

Tombstone, around which hangs a history typical of the early days of the West, is again taking on an industrial appearance in consequence of the efforts being made by the Bunker Hill Mining Co.—a Phelps-Dodge subsidiary. Tombstone was discovered in 1878. The ore contained gold, silver, and lead. At first silver was the principal constituent of the ore, but as the mine workings were extended in depth, it was found that the proportion of gold to silver rapidly increased, so that the value of the gold greatly exceeded that of the other metals. The camp became one of the largest in the South-West and produced about $35,000,000. At a depth of 560 ft. below the surface, the water-level was reached, where the flow was so great that all attempts to control it failed and the miners were obliged to dis-

*Director, Arizona State Bureau of Mines.

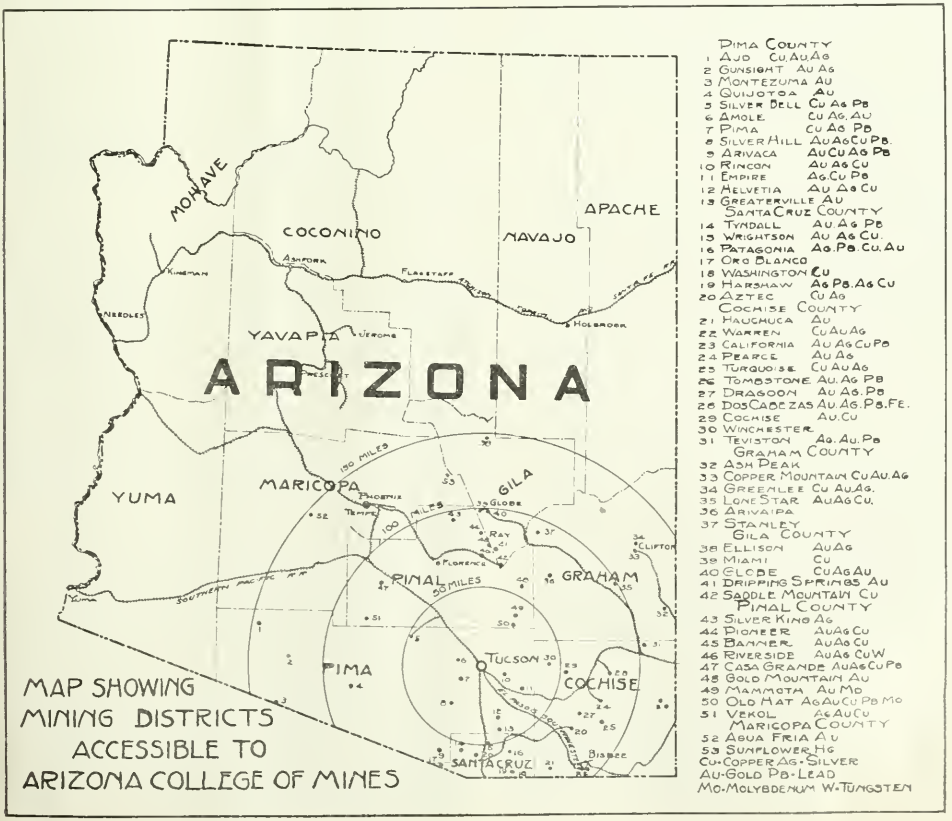
continue operations. The present owners are working a force of 300 men. Ore is now being milled from one of the old shafts; this ore averages between $5 and $7 per ton. The old tailing-dump is valued at about $4 per ton, and this also is being sent to the mill, which has been entirely re-modeled. The all-sliming cyanide process is being used. At the old shaft where millions of dollars were spent in a vain endeavor to drain the district, a modern pumping- plant is in operation and water is being raised to within 70 ft. of the surface, and is handled from there by an air-lift.

Construction plans have also been a notable feature of Arizona mining in the past month. A contract has been let for the construction of the Tucson, Ajo, & Gila Bend railroad and the completion of the Gila Bend-Ajo link is expected by January 1. Work will then be rushed on the Cornelia reduction works of 4000 tons daily capacity to handle the 40,000,000 tons of copper ore that has been developed. Leaching and flotation processes are to be used. Probably $5,000,000 will be expended before production begins.

Much activity in mill-building is evident in the gold-fields in the northwestern corner of the State. Three new mills are about to be erected and within 90 days it is expected that there will be two additional plants. Work is being rushed on the construction of a mill for the United Eastern mine, at Oatman, in order to derive a revenue as early as possible from the large body of high-grade opened up on the 460 and 565-ft. levels. The assay-value of this ore is said to be about $2,000,000 and it is being rapidly increased by the development work. The general average of the ore opened west of the shaft on the 565-ft. level is $36.60 per ton across a width of 22 ft. The initial unit to be erected will have a capacity of 150 tons daily.

C. E. Finney, of Los Angeles, representing the London-Arizona Copper Co., which has just sold the London-Arizona, the London-Range, London-Shamrock, and Ball groups to the American Smelting & Refining Co., has secured control of the M'Cracken silver mine, an old producer and arrangements are being made to place upon the property a 500-ton reduction plant to handle the $700,000 of ore said to be in reserve.

In the Wickenburg district, mills are to be erected for the Monarch and Grijavla mines. The Monarch is a copper-gold mine. The Grijavla Neavo Mining Co. is building a mill and tram to treat the 24,000 tons of ore now available. A pumping-plant of 150 gal. per min. capacity will deliver water from the Hassayampa river to the mill, a distance of 4000 ft. and an elevation



of 600 ft. The Grijavla is a coarse-gold lode and many pieces of considerable size have been found in its ore. The present company acquired control of the property only last April.

The striking of ore on the 1600-ft. level of the United Verde Extension Mining Co., in the Jerome district, has brought renewed vigor into its operations as well as giving its stock a decided boost. Improved facilities for handling the ore are under discussion and it is expected that a tram down the hill to the V. T. & S. Ry. will be built shortly as this would afford excellent shipping facilities to the Clarkdale smelter.

Gold has been found in the Christmas district, which has heretofore been actively mined for copper. The gold is coarse and ore averaging $200 per ton has been shipped. Although the presence of asbestos in Gila county has been known for some time, it has only just been shown to exist in commercial quantities and is of the long-fibred variety. The strike in the Commonwealth Extension, at Pearce, is proving larger with development work. Since striking the ore 80 ft. has been driven and the assays run from $20 to $60 per ton. It would appear that the Juniper Flats district will give Arizona another goldfield.

Oil Production of the World in 1914

The quantity of petroleum entering the markets of the world in 1914 amounted to 400,483,489 bbl. according to statistics compiled under the supervision of J. D. Northrop of the U. S. Geological Survey. They are as follows:

	1914.		1913.	
Country.	Production.	%	Production.	%
United States	265,762,535	66.36	248,446,230	64.59
Russia	67,020,522	16.74	62,834,356	16.34
Mexico	21,188,427	5.29	25,902,439	6.73
Rumania	12,826,579	3.20	13,554,768	3.52
Dutch East Indies	*12,705,208	3.17	11,966,857	3.11
India	†8,000,000	2.00	7,930,149	2.06
Galicia	†5,033,350	1.26	7,818,130	2.03
Japan	‡2,738,378	.68	1,942,009	.51
Peru	1,917,802	.48	2,133,261	.55
Germany	†995,764	.25	†995,764	.26
Egypt	777,038	.19	94,635	.03
Trinidad	643,533	.16	503,616	.13
Canada	214,805	.05	228,080	.06
Italy	39,548	.01	47,256	.01
Other countries	**620,000	.16	†270,000	.07
Total	400,483,489	100.00	384,667,550	100.00

*Includes British Borneo; †Estimated; ‡Includes Formosa; **Includes 600,000 bbl. produced in Argentina.

The total of the world since 1857 is 5,593,262,936 bbl., of which the United States yielded 3,335,457,140, and Russia, 1,622,233,845 barrels.

WATER in a heavy stream poured directly upon the chip at the point where it is being removed from the steel forging by the tool permits an increase in the speed and allows of a 30 to 40% increase in the amount of work done; with cast-iron the gain is 16%.

Oil in China

The Standard Oil Company of New York is said to be pushing operations in the Chinese oilfields and recent reports from China state that the National Oil Bureau is confident that an extensive supply will be found by the wells now being drilled. The latest news is that the company has stopped wells No. 1 and 2 in the Yen Chang district of Shensi and is boring new wells at Tuanchiawan and Huailiho. These regions had previously been surveyed by the company's geologists.

The above item is of great interest to one of our engineer friends, who tells us that he visited Yen-chang in 1899. At that time the Pekin Syndicate had a concession for any petroleum found in the Province of Shansi, which lies just east of the south-flowing Yellow river, while Shensi lies to the west. Extensive search for eight months, the placarding of the province of Shansi (which is about as large as England and Wales) and offering rewards running from a few taels (say, 70 cents) for report of oil indications up to 10,000 taels, to be paid after development of a well producing 100 bbl. per day, failed to bring out any oil in Shansi. The nearest approach to oil was an iridescent scum of iron oxide found on the surface of a quiet pool hidden in a deep ravine. This rainbow film was the only thing resembling oil to be seen in Shansi. It took 14 days steady travel to reach the pool.

Shensi, however, has been noted for its oil occurrences for centuries. Marco Polo, a geographical prodigy, was the first to speak of the "fire-fountains" of Shensi, but all memory of them seems to have been lost, as far as the local Chinese are concerned. No fiery fountains have been seen for generations. There is doubtless some foundation for the story.

Our mining engineer friend saw two oil-springs; one at Yen Chang Hsien, a miserably poor hamlet some miles west of the Yellow river. The geology of this part of China is simple: overlying a thick deposit of limestone is the shale of the coal formation and above this is found a brown sandstone of great thickness. The Yen Chang district is in this upper sandstone and the oil was found oozing out between the layers of the sandstone not far above the little stream on which the town is situated. The total amount of oil flowing was not more than a quart per day. Similar springs were said to be nearby. Another spring was seen some 30 miles away in a southerly direction. Here the ropey oil floated on the surface of a pool 30 ft. in diameter at the base of a sandstone cliff. The oil was skimmed off when wanted; and used as medicine; and also in lamps, when the crops failed and bean-oil was lacking. A peculiarity of the deposits is their occurrence in horizontal, or at any rate, only slightly disturbed strata. Oil experts in London, to whom the deposit was described, thought that the chances of developing an oilfield were not good, but the Standard Oil Company, with its wider experience, seems to have faith. Where oil indications are scattered over so wide a territory, it does seem that the chances for finding productive wells are good.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Fuel-oil vaporizes at 130° Fahrenheit.

The choice of power in churn-drilling cannot affect the cost except to a minor extent.

Calcium carbide (lime and coke) is made in an electric furnace at a temperature of 7000°F.

Falling water is an active resource. Power is inherent therein. If not captured, it is unused, unproductive, and wasted.

Fire-brick production, which accounts for 12.68% of the value of all brick and tile products of the United States, rises and falls with the fluctuations in the iron and steel and coke-making industries.

When using heavy oils in large oil-fired furnaces it is necessary to use oil or steam at 80-lb. pressure in order thoroughly to atomize the oil and distribute the heat, but in small furnaces 20-lb. pressure will suffice.

Ten 1360-lb. stamps at the Empire mill, Grass Valley, driven by a 35-hp. back-geared motor, use 31.5 horsepower. By the use of this style of drive a saving of about 5% was made, compared with the old drive.

Churn-drilling results at the Sacramento hill, Bisbee, Arizona, are being proved by underground work. One hole, which gave an average of 3.80% copper, has been followed by a raise that yielded 3.79% ore, showing good work.

A soldering composition for aluminum consisting of the following elements in substantially the following proportions: block tin, 80; lead, 16; aluminum, 8; zinc, 16; and phosphorus, 8 parts, is among the recent patents issued at Washington.

Formaldehyde is a water-white liquid, which, if of full strength, contains 40% formaldehyde gas. It has a strong odor, which, however, practically disappears in the diluted form in which it is generally used. It is a powerful disinfectant and antiseptic.

A man with an electric-hammer may be expected to do about as much work as six men working by hand. This is easily explained by the fact that a man with a hammer strikes from 50 to 80 blows a minute, while the electric-tool strikes from 1400 to 4000 in the same time.

Silver is chiefly produced as a by-product of copper and lead smelting. For example, 14 of the largest copper and lead companies in North America have a total annual output of 108,000,000 oz. silver, while the 14 largest silver companies have a total output of only 21,500,000 oz. Anaconda alone produces more than half as much silver as the total of the 14 silver-mining companies.

The efficiency of a reciprocating air-compressor is ordinarily stated as the ratio of the work done upon the air, as shown by an indicator-diagram from the air-cylinder, to the work performed by the steam, as shown by the area of the indicator-card taken from the steam-cylinder.

Fifteen stamps, one Chilean mill, and four grinding-pans at the Eldorado Banket gold mine, in Rhodesia, reduced 57,073 tons of ore in the year ended March 31. The duty was 5.25 and 84.07 tons for the first two machines. The three stages cost a total of $1.18 per ton treated.

Sulphur is successfully used in setting holding-down bolts for machinery. A cracked centrifugal pump was patched temporarily recently with a rich cement mixture, but the bond between this and the pump did not hold. Molten sulphur was then run into the crack, making a tight joint.

Viscosity of lubricants may be determined in the following manner: A metal strip is coated on both sides with the lubricant, and placed between two cylinders, held against it by weights. Known weights are hung on the strip, and from the relation between the various weights at equilibrium the viscosity is found.

High-speed steel is comparatively little understood, although a great deal of work has been done on it. It is a material which may be very complicated in composition. It may contain as essential constituents iron, carbon, silicon, manganese, tungsten, chromium, vanadium, molybdenum, and cobalt. Many of the ultra steels contain as many as eight of these elements. The range of composition of the English high-speed steels is as follows: carbon, 0.45 to 0.85; silicon, trace to 0.2; manganese, 0.1 to 0.5; tungsten, 8.0 to 18.0; chromium, 2.5 to 6.5; molybdenum, 0.0 to 2.0; vanadium, 0.0 to 1.5; and cobalt, 0.0 to 5.0 per cent.

Fusible-tin boiler-plugs have been reported as failing to melt and give warning. An investigation by the Bureau of Standards shows that the tin filling in these cases had become oxidized to tin oxide (SnO_2), which has a melting point above 2900°F. One pronounced and dangerous type of deterioration is the oxidation of the tin along the grain boundaries, by which is formed a network of oxide throughout the tin. This is shown to be due to the presence of zinc in amounts as low as 0.3%. Lead and zinc are found to be the principal impurities in tin-plug fillings, and since all 'failed' plugs contained these or other impurities, the conclusion is reached that if these impurities are eliminated by strict specifications and inspection, which will allow only admittedly superior qualities of tin, such as Banca and some others, the danger of failures of these plugs will no longer exist.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

CRIPPLE CREEK, COLORADO

Gold Output.—Cresson Dividends.—Hondo Development.—Drainage Adit.—Nagel Lease.—Compensation at the Portland.

The estimated gold production of the district in July is as follows:

Plants.	Tons.	Average value.	Gross value.
Smelters	4,000	$55.00	$220,000
Golden Cycle	37,000	19.00	603,000
Portland (Colorado Springs)	11,000	20.00	220,000
Portland (Cripple Creek)	17,800	3.05	54,290
Portland (Independence)	11,000	2.42	26,620
Wild Horse	850	3.50	2,975
Kavanaugh-Jo Dandy	400	2.00	800
Total and average	82,050	$13.74	$1,127,685

Although the tonnage treated in July was considerably larger than in June, the grade was a little lower. For this reason the total was less than in the previous month.

During July about $200,000 was paid in dividends. During the first quarter of the current year the Cresson Gold Mining Co. distributed $1,050,000. This includes a special dividend of $1,000,000 in addition to the regular dividend of 5% on its capital of $1,000,000. This company is a close corporation. It is reported that the dividend for the second three months is about the same as that given above.

A rich discovery was reported a few days ago in the property of the Hondo Gold Mining & Milling Co on the 'saddle' between Battle mountain and Bull hill. In sinking a winze from the 200-ft. level, 5 ft. of ore was opened. A rich streak of quartz-bearing sylvanite was found on the hanging wall. It is rumored about the east end of the district that this company will build a small mill this fall to treat the low and medium-grade ores which were exposed recently in sinking the shaft.

The directors of the Roosevelt Deep Drainage Tunnel Co. have decided to continue the work on company account. It is estimated that a little more than 8000 ft. of work remains to be done before cutting the main water-courses of the Golden Cycle mine. This work will be done as rapidly as possible. C. H. Fuller is in charge of operations. The Nagel lease on the adit level of the Portland mine is making splendid profits.

In a notice recently sent to each of its employees, the Portland Gold Mining Co. has decided to accept the provisions of the Workmen's Compensation Act. This provides for the payment of certain fixed compensation to employees for personal injuries accidentally sustained in working for the company. This act became effective on August 1, 1915. In order to supplement the benefits under this act, the Portland company placed before its employees two propositions, namely: (1) The new law provides benefits only for accidents sustained by the employee while engaged in his regular work. The Portland company proposes to erect in the Cripple Creek district a first-class hospital with modern equipment. This hospital will be open to all employees in case of sickness, as well as in all cases of injury through accident, whether such sickness or injury arises when the employee is on or off duty. The company will also furnish and equip, at its own expense, a first-aid office on its property, where immediate first-aid may be applied until injured persons may be cared for at the hospital. For such hospital, medical, surgical, and first-aid service the company will deduct $1.25 from the monthly pay of each employee. (2) Under the new law the employee receives no compensation whatsoever for the first three weeks of his disability through accident, nor does he receive any benefits during said period, except actual surgical and hospital aid, etc., not exceeding $100 in value. The Portland company proposes to form, with its employees, a mutual plan of insurance without assessment features. Each employee will be required to contribute 1% of his monthly wages. The company will contribute an equal amount. From this fund, contributing employees, while unable to work by reason of sickness or injury, will receive half pay during the first three weeks of disability. As a result of a vote, participated in by every employee of the company, the two proposals were unanimously accepted. This is but another example of the broad-minded, efficient, and far-seeing policy of the Portland company toward its workmen.

GOLDFIELD, NEVADA

Merger-Jumbo Extension Agreement.—Jumbo Extension Development.—Merger Capital.—Atlanta, Great Bend, Silver Pick.

The end of litigation at Goldfield, pending and threatened, was signalized this week by the action of the Federal court at Seattle, in discharging Carl M. Johanson, receiver of the Merger Mines Co. Prior to his dismissal, an agreement was filed with the court, terminating all disputes between the Merger and the Jumbo Extension companies. This agreement includes that the Merger company admits that the Jumbo Extension company is the lawful owner of the Velvet Lode mining claim, now in its possession, and of all the minerals within the exterior boundaries thereof, extending downward vertically, and release and quit claim to said Jumbo Extension company any and all right therein. This agreement also constitutes a perpetual side-line agreement between the companies, and provides that either may use workings of the other when such use will not interfere with regular operations. The last named provision is merely a matter of form, as neither company is likely to have any use for workings of the other, but it is planned to make air connections between workings of the two mines on the 1017-ft. level in the near future.

It is estimated that the net production of the Jumbo Extension in July was approximately $60,000. The secretary, Ben Gill, states that returns from June shipments, still incomplete, indicate a production larger than estimated, and probably slightly over $55,000 net. A production of about $60,000 net monthly, will be made until the Velvet shaft is completed, when the output will be approximately doubled. The mine continues in excellent condition and stoping is now in progress from drifts east of raises 503-B and 503-C, in the big quartz fissure that penetrates the shale and below the contact ore-channel. It is estimated that the new orebody, exposed on the shale-contact and south of the 524-ft. drift, contains shipping ore worth $3,000,000. The mine contains a large tonnage of ore of lower grade, containing copper and silver, which will be treated profitably by the concentration-flotation process recently evolved here.

On the 1175-ft. level of the Merger, the drift following the shale-contact and driven from the Grizzly Bear shaft of the Consolidated, has progressed over 280 ft. Raises have been

driven at intervals, through 40 ft. of silicious material, marking the contact, to the overlying latite. The character of the quartz is more encouraging, as the drift progresses, and it is thought that the extension of the Jumbo orebody will be exposed soon. The manager, A. I. D'Arcy, has left by auto for a month's vacation in California. His assistant, William Sharp, is now in charge of the Merger, Atlanta, Sandstorm-Kendall, Kewanas, Booth, and Blue Bull properties, of which Mr. D'Arcy is manager. The special meeting of shareholders of the Merger company, August 4 at Seattle, was for the purpose of ratifying the agreement with the Booth company, increasing the capital stock from 5,000,000 to 6,000,000 shares, and authorizing the payment of 750,000 shares to the Booth company, in settlement of the apex claims of the latter.

Good results are reported in further opening the ore on the 1660-ft. intermediate level of the Atlanta, as well as at the newer discovery, 100 ft. farther north, and on the 1620-ft. level. A raise from the 1750-ft. level is being advanced to connect with the south drift on the 1660-ft. and to develop the ore between these levels. The drift at 1620 ft. will be extended to connect with the same raise. Shipping ore has been assaying from $32 to $41 per ton, and the manager reports the presence of ore of lower grade, varying from $8 to $20 per ton, in large quantity.

The main shaft of the Great Bend property has been cleared of water and debris, and development will now proceed on the 400-ft. level, where a drift and cross-cut had been extended and some rich ore exposed in a short raise several years ago, when the miners were driven out by water. The property has been equipped with an excellent surface plant, and with pumps of ample capacity. J. K. Turner is consulting engineer and Jack Campbell, a pioneer mining engineer of the district, is manager. Great Bend has shipped about $70,000 in high-grade ore in the past, and old assay records show that ore of good grade was found at several places.

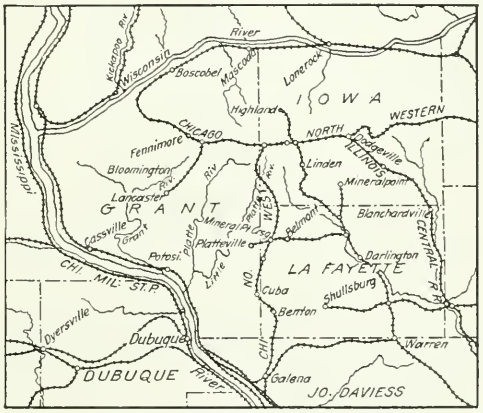
Work of the Silver Pick Consolidated is at an interesting stage. The west cross-cut on the 500-ft. level has penetrated the Phelan vein, and proves it to be 16 ft. wide, of low-grade quartz. Drifts are now being started north and south on this vein. The east cross-cut on the 700-ft. level has been in a broken formation, indicating heavy faulting, and is apparently nearing the main vein, explored to some extent on the 500-ft. level, and which is apparently the north extension of the Combination vein of the Goldfield Consolidated.

PLATTEVILLE, WISCONSIN

Situation of the Zinc Producers in July.—Malm Process.—Lead.—Pyrite and Sulphuric Acid.—Carbonate of Zinc.—District Yields.

July resulted in large and interesting developments in all branches of the zinc-lead mining industry of the upper Mississippi Valley districts. Continued high prices for metal and ore made its influence felt. While production showed no large increase, shipments were much better than usual. Buying was centred on the highest grades of zinc concentrate but the ban on inferior grades was lifted somewhat, and purchases were made during the latter part of the month down to 40% zinc-content. This did not help to diminish the reserve in the field, which at the close of the month aggregated 10,000 tons or more. Optimism as to prices prevailed, and not a siugle organization in the field relinqnished its efforts to maintain a maximum output. This feeling was extended in other directions, and the month's work was done nnder conditions that can be ascribed to boom periods. New capital became interested, especially in the southern districts where great strides are being made in the development of new land for zinc-mining purposes. Abandoned properties have been resurrected, and every available foot of ground has been secured by mining leases. Agents of local operating concerns, landowners, and lessees have been swarming in the hotel lobbies of Milwaukee, Chicago, St. Paul, and nearby cities, soliciting financial backing for various projects. Large profits are being made on account of low costs, which are down to including separator treatment, less than $15 per ton of concentrate. It is this high-grade separator product which is now in constant demand that is bringing from $95 to $110 per ton. No great recession in price was experienced during the month. The operators in the field prepared to refine low-grade ores have become aroused to the real needs of the region, and snbstantial gains were made in treatment capacity at all plants.

The Malm process of separation is attracting considerable attention. It is claimed to make a complete and separate recovery of all contents in ores, besides entirely eliminating the smelters. The general principles of the process are briefly as follows: the ore, properly dried and crushed, is fed into one end of a tube-mill, where it is subjected to the action of chlorine gas, being kept in contact with the gas long enough to chloridize from 40 to 70% of the metal-content. The ore is conveyed to a roasting-furnace, where the heat breaks up the iron chlorides and liberates chlorine free or as hydrochloric



ZINC DISTRICTS OF WISCONSIN.

acid, leaving the iron in an inert oxide condition. This acid unites with the sulphides forming chlorides of the metal-contents. The ore is passed to an agitator, solution is added and precipitation commenced. The various precipitates are separately collected in filter-presses, dried, melted, and cast into bars. Numerous tests have given extractions of over 90% of all the metals in an ore. The products obtained are in the most concentrated form possible for shipping to market. Great claims are made for the process. Leading mining men are interested, and a plant is proposed at a central point in the field to test the method.

Lead ore was in poor demand all the month; sales and shipments were very light. $60 per ton for 80% metal-content held throughout the month. The reserve at all points in the field gained considerably, as most of the lead secured in this region is obtained as by-product in the process of wet concentration, the heavier the output of zinc ore the greater the recovery of the lead. The close of the month found 2500 tons in bins. Miners were showing no desire to sell at prevailing figures.

The production of pyrite was confined to product secured at separating-plants. Fines were in good demand at $3.75 to $4 per ton of 50 units, and the ore cleared for reduction in sulphuric-acid works. The New Jersey Zinc Co. will restore its acid-plant at Mineral Point, shut down five years ago on account of damage-suits brought against the company for injuries worked to shrnbbery, trees, and lawns in the vicinity. A device has been patented which controls the fume. The

original plant represents an investment of $1,000,000, and gives employment to several hundred men. One 25-ton tank car of commercial sulphuric acid was shipped daily. More low-grade ore will now be in demand to supply the necessary material. Miners, especially low-grade producers, have taken new hope from the proposals.

Producers of carbonate of zinc received the highest prices ever known for this ore, the first days of the month recording $60 to $70 per ton 40% base zinc-content. Miners engaged in producing this ore are beginning to give up all hope of ever deriving any returns from their mines on account of the conditions of disposing of their product.

Deliveries of ore by districts were reported as follows:

Districts	Zinc Pounds	Lead Pounds	Pyrite Pounds
Benton	12,638,000	354,800	344,000
Hazel Green	4,944,000	289,000	.....
Galena	4,878,000	.....	.....
Cuba City	3,728,000	.....	2,449,220
Livingston	3,148,000	.....	.....
Platteville	3,130,000	.....	.....
Linden	942,000	186,580	.....
Mifflin	764,000	.....	.....
Shullsburg	708,000	.....	.....
Potosi	118,000	.....	.....
Highland	108,000	.....	.....
Dodgeville	104,000	50,000	.....
Mineral Point	102,000	.....	.....
Total	35,312,000	880,380	2,793,220

DEADWOOD, SOUTH DAKOTA

Water-Rights Dispute.—North Homestake.—Homestake Improvements.—Wasp No. 2 Tungsten.—New Mill.—Echo.—Trojan Sampler.—Rattlesnake Jack and Mogul Mills.—Tungsten and Gold.

To the end of July, the rainfall in the Black Hills for the current year is over 28 in., the average annual precipitation at Deadwood being 20 in. Springs and gulches are seldom running at this time of the season, so there is an assured supply for the remainder of the year.

Opposition is developing against the diversion of waters of Elk and Bare Butte creeks, petition for which diversion J. T. Milliken has made through the regular channels, namely, the office of the state engineer of South Dakota. Mr. Milliken wants the water for milling and other purposes at the Oro Hondo mine. Those opposed to him in this matter include the owners of the Clover Leaf mine, at Roubaix, on Elk creek; farmers along both creeks, and the United States government, which is interested on account of using at Fort Meade, a supply secured from Bare Butte creek. A hearing will be held by the state engineer at which the contending parties will be heard. Mr. Milliken's diversion would be located near the head-waters of Elk creek. His contention is based on a state statute which permits water to be appropiated that has not been used for three years. Just what influence prior water-rights would have, which are located down the stream, is a question that has not yet been settled by rulings nor in court. For that reason considerable interest attaches to the proceedings now under way. Mr. Milliken has the good wishes of residents of the Black Hills, as the complete development of the Oro Hondo would mean the adding of a large producer to the present list, but it is apparent that these same residents are not willing to let him take their water. The Oro Hondo shaft is steadily being deepened; it is now 1650 ft. below the surface. Cross-cutting is under way in both directions on the 1500-ft. level.

Water has been removed from the underground workings of the North Homestake company, at Maitland, the small compressor placed on a new concrete foundation, and other incidental repairs and improvements made. It has not been announced whether lateral work or sinking will be done.

Construction work for the many improvements at the Homestake, at Lead, is being continued steadily. A big landmark was erected when No. 1 smokestack was recently completed at the new boiler-plant. This stack is 220 ft. high, constructed of sheet-steel on a massive foundation of reinforced concrete. Work has been started on the second stack, which will be similar to the other. The boiler-house roof having been completed, the tramway has been built over the coal-bunkers, and the chutes are being installed. Work of installing the boilers will soon commence. At the B. & M. shaft the head-frame is finished, also practically all work in erecting the great hoisting-engine. Part of the shaft-house has been completed. The air-compressor, which will supply air for operating the clutches, reversing-gear, and brakes on the hoist, is being installed, but not until the boiler-plant is ready to furnish steam for the hoist will the old compressor and boiler-room be torn out to make way for the immense new machine which will furnish air for some of the drills in the mine. The electric-plant building is completed, a portion of the machinery installed, and at the rear of it erection of the condensers has been started. Efforts are being made to complete all of the new work before cold weather.

As mentioned in the Press of July 17, tungsten ore is being extracted in small quantities at the Wasp No. 2 gold mine, at Flat Iron. Even though in small quantities, its gross value in the course of a month runs into thousands of dollars. The company is particularly fortunate to have found it at this particular time, as $9 per unit was realized for the last shipment. The material will average nearly 40% tungsten trioxide. It is probably wolframite, as analyses show it to contain both iron and manganese in considerable quantities. It also contains about $20 per ton in gold. The tungsten buyers do not pay for the gold-content. The usual dividend of 1c. per share was paid on July 15.

The newest mill to be added to the list of producers in the Black Hills is that of the Rattlesnake Jack, at Galena. It started on July 19. The plant is equipped with 10 stamps, Hardinge mill, Dorr classifier, and Trent cyanidation system. It is one of the most complete in the Hills, and reflects up-to-the-minute practice in all departments. C. B. Harris is manager.

Shaft work is progressing favorably at the Echo property at Maitland. From June 16 to July 19 the shaft was deepened 29 ft., notwithstanding trouble with the sinking-pump. Considering everything this was good work. Two shifts of miners are employed. The sinker is operated by compressed air.

Among the improvements that have been made at the Trojan mill, at Trojan, South Dakota, is a device by which an accurate sample of the mill-feed is procured each day. At the head of the conveyor that delivers the crushed ore to the mill-bin a slow-moving pulley has been installed; this actuates a sheet of steel that is interposed against the stream of ore at intervals of about 90 seconds, diverting the entire stream for about 2 seconds to a chute leading downward through the floor of the bin. By this means a sample comprising about 2% of the full mill-feed is secured. This sample may be diverted to either one of two sample-bins, which will hold 6 tons each, the maximum amount cut from a day's run of 230 to 250 tons of ore to the mill. From this bin, chutes lead direct to a small grizzly at the lower end of which is a Samson sample-crusher. The entire content of the bin is put through the grizzly and crusher, drops to the boot of a bucket-elevator, at the head of which the ore is divided in a chute, half going to the mill-bin, and the remainder to a third sample-bin. After the first sample-bin has been emptied, the grizzly opening is made smaller, the jaws of the crusher are set to give a finer product, and the contents of the third bin are put through a smaller mesh. During this operation the sample

is 'circulated' and continually cut down at the head of the elevator until it amounts to only 100 lb. It is then further reduced by shoveling over a split-sampler until its quantity is small enough for the assayer. The equipment in all details is well arranged and undoubtedly gives as nearly a correct sample as it is possible to secure under present conditions.

The mill is well arranged and many of its details are worthy of mention. One of the most noteworthy achievements learned on a recent visit was that an average of 230 tons was being crushed daily by one 7-ft. Trent Chilean mill through a screen of 0.021-in. opening. The ore is medium hard, and this duty for a single machine is probably a performance unequalled anywhere. The company is on a good profit-earning basis, and has several years' ore supply in sight.

The Rattlesnake Jack mill, near Galena, is working well. The plant includes 10 stamps, a Hardinge pebble-mill, Trent cyanide system, and Merrill precipitating-press. The daily tonnage is from 70 to 80 of hard ore.

Engineers representing W. Flynn and Senator George Oliver, of Pittsburg, are making a thorough examination of the McHugh and Gillmore properties, between Lead and Deadwood, and adjoining the Homestake. They are sampling the workings, and will do several thousand feet of diamond-drilling.

John R. Mitchell, of Denver, is investigating the Lexington Hill properties, which have been represented to him as containing an immense quantity of low-grade cyaniding ore.

Another De La Vergne oil-engine of 100-hp. capacity is almost installed in the Mogul mill, at Terry. This will increase the mill duty to about 200 tons per day. The new engine is of the same type and size as the old one, but is a later model, and contains some improvements. It will be used for driving the crusher, another Chilean mill, and some small machinery, including air-compressors, diaphragm-pumps, etc. The increase in tonnage at the plant will permit the handling of a lower-grade material, which occurs in large quantities in the stopes. Demands for handling custom ores have been numerous, so the management decided an increase in capacity was justified. In the past few weeks some of the old tailing from the Kildonan chlorination mill, at Pluma, has been shipped to the Mogul mill for cyanidation. As this material assayed over $6 per ton, it yielded a good profit.

Sixteen thousand dollars was recently received by the Wasp No. 2 Mining Co., operating at Flat Iron, for 40 tons of wolfram ore recently shipped to the Primos Chemical Co., Philadelphia. The shipment was hand-sorted from over 200 tons of ore. The reject is on the dump and in the bin, at the mine, in two grades as sorted, and will be marketed later. Production of the rich material continues. The ore now exposed is as good as it has been at any time in the past four months; it lies on top of and in quartzite, in a poorly-defined shoot 12 inches thick, and four to seven feet long. At the edges it is broken, and the wolframite spreads out in narrow seams. Immediately above the quartzite is a stratum of sandy shale a foot thick, and above this about an equal quantity of sandstone; next above is shale. The richest ore appears to be a replaced quartzite, although some of the purest of the wolframite occurs in a sandstone matrix. While this is not the first production of wolframite from this property, five tons having been shipped some years ago, it is the first important discovery made. It was found near the roof of a stope being excavated in the gold-bearing quartzite, which is cyanided, and an odd feature is that extraordinarily rich gold ore, sometimes assaying thousands of dollars per ton, is found in small quantities in the wall-rock of the ore-shoot. The wolframite itself assays $15 to $20 per ton in gold. The shipment yielded over 56% tungstic oxide, and the lower-grade ore on the dump will average 10%. The company's cyanide-plant continues to treat an average of 500 tons of gold ore per day, assaying about $2 per ton. Bumping-screens have replaced the stationary-screens long in use. The usual monthly dividend of 1c. per share was paid in July, and the August rate may be higher.

LEADVILLE, COLORADO

Dredging at Leadville.—Down Town Areas.—St. Louis Gold Ore.

The first dredge to operate in the Leadville district was launched on August 5, by the Empire Gold Dredging Co. Great interest was taken in the event. The company was incorporated here early in the spring, and immediately proceeded under the management of Robert E. Lafferty to purchase the large placer area along the Arkansas river and Box creek, known as the old Derry ranch, as mentioned in the Press at the time. The ground includes about 300 acres of the richest gravel in this region. It has been thoroughly tested, and averages 30c. gold per cubic yard. Complete title to the land and the water rights were obtained near the first of April. Machinery and supplies for construction of the boat began to arrive about the fifth, and actual work on the building was started on the tenth. Since then some 30 carloads of machinery have been delivered at the siding near the site, and a large force has been engaged assembling parts and constructing the hull. The boat is 107 ft. long with a 42-ft. beam built of the heaviest California timber.

The machinery is now being installed on the hull. Some of it is heavy. The large revolving-screen weighs 30,000 lb.; spuds 50,000 lb.; and the bucket ladder 108,600 lb. When the boat is complete it is expected to draw about 8 ft. of water. The dredge should affect the prosperity of the district. Mr. Lafferty is confident that the boat will operate for from 10 to 15 years on the ground that he now controls. There are many other smaller tracts of valuable ground in the district suitable for dredges. The boat should be at work early in October, and will operate steadily all the year.

The draining of the Down Town basin of the Leadville district is progressing steadily, and in the most satisfactory manner. The pumps will be described in detail in the next issue of the Press, accompanied by a plan of the shaft and chart of pump efficiency.

Ex-governor Jesse F. McDonald, who is manager of the company and directly in charge of the work, is highly pleased with the progress and states that actual mining in the drained areas will be under way by the first of 1916. The opening of the Down Town basin to mining is expected to result in one of the largest and richest ore-producing areas. The ground controlled by the company is roughly estimated to be three miles square, and is known to be rich in lead, zinc, silver, iron, and manganese. The most extensive operations that have ever been carried on here are planned by the Down Town company.

The richest property that has been developed in the Leadville district this year is the St. Louis adit now being operated under the control of the Third Venture Mining Co. W. A. Palmer, of Boston, is president and is in charge of the work. The largest shoot of high-grade gold ore that has been opened here since that of the Little Jonny on Breece hill has been opened in the St. Louis adit. The adit adjoins the Jonny and other claims of the Ibex Mining Co. on the north slope of Breece hill, and it is the extension of one of the rich shoots from the former that is now producing the ore in the St. Louis. Mass gold, from several inches in diameter to that of a small pea is being taken from the vein at the rate of about $2000 per day. Mr. Palmer states that the orebody is continuous, and in places extremely wide. He is confident that the shoot as now developed will afford mining at the present rate for a number of years. He has a seven years' lease on the ground. In addition to this rich ore, several large bodies of rich shipping ore have been opened in the property, and a large tonnage of this material is being extracted. The present operators of the St. Louis have been working for a number of years without success, and the continuation of developments have often been despaired of by Mr. Palmer, because of the heavy expense. He, however, had confidence in the property, and is now making excellent profits.

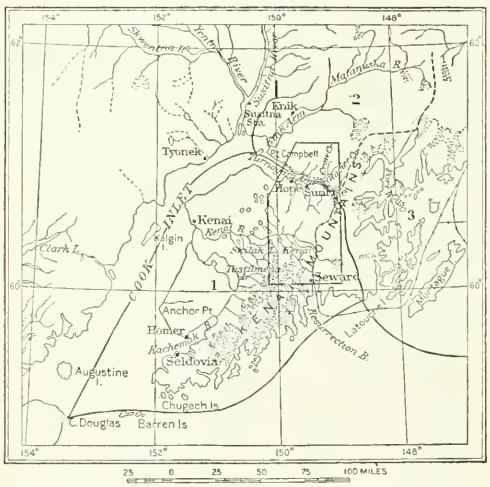
THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

On July 30 the Workmen's Compensation Act became effective. The provisions are liberal, the largest amount being $6000.

The geology and mineral resources of Kenai peninsula are described in Bulletin 587 of the U. S. Geological Survey by G. C. Martin, B. L. Johnson, and U. S. Grant. With maps it covers 243 pages. The area, 9400 sq. miles, lies between Prince William sound and Cook inlet, and is almost separated from the rest of the continent by the waters of Passage canal or Portage bay, and of Turnagain arm. There are two distinctly dissimilar districts, the mountains and the lowlands. Seward is the largest town. Alfred H. Brooks states that the peninsula contains auriferous lode-bearing areas of some promise,



MAP SHOWING THE RELATION OF THE AREA DESCRIBED IN THIS REPORT TO THE KENAI AND KNIK RECORDING DISTRICTS.

1, Kenai recording district; 2, Knik recording district; 3, Valdez recording district.

though deep mining has so far been done on only a small scale. Gold-bearing gravels are widely distributed in the northeast part and for nearly 20 years have been worked in a small way. The future of placer mining here depends on large-scale operations on low-grade gravel. Large deposits of lignitic coal occur on the Cook Inlet side. Hydro-electric power is possible. Timber is sufficient for local use. There is good fishing and hunting. Work done and being done is given in detail.

Fairbanks

The strike of placer workers ended here on July 24. The trouble arose over hours and pay.

ARIZONA

Mohave County

The United Eastern mine has made its first shipment, consisting of 35 tons of $30 ore. This went to the Gold Road mill. It is intended to mine about 1000 tons per month. The ore comes from development at 460 and 565 ft., and future extraction will be from these levels. The west drift at 460 ft. has a length of 190 ft., and the east drift at 565 ft. is 210 ft., making a total of 400 ft. in the ore-shoot. The face of each drift is filled with ore, and there are no indications of its getting narrower. On the dump is about 2000 tons of good ore.

Pinal County

The Ray Consolidated Copper Co. reports as follows for the second quarter of 1915:

Results of operations	Second quarter	First quarter
Mine development, feet	10,769	.....
Cost of mining and crushing, cents per ton	60.959	.....
Ore treated, tons	679,004	656,672
Average metal-content, per cent	1.677	1.667
Copper output, pounds	14,524,380	14,463,213
Copper from ore shipped direct, pounds	277,851	.....
Cost of treatment, cents per ton	44.53	48.95
Cost per pound, cents	9.057	.....
Net profit	$1,340,886	$741,539
Dividend paid	547,035	.....
Surplus	$793,851	$741,539

Yavapai County

The Western Investment Co. is considering the driving of a long development, drainage, and transportation adit to develop all the veins between the Bradshaw Mountain railway, two miles below Crown King, and a point near Hooper, at depths from 1000 to 2200 ft.——The Arkansas and Arizona Mining Co., operating at Jerome, is being re-financed. The mine is opened to 1648 ft., with good equipment.——Six miles from Prescott the Arizona Mine Supply Co. is to sink to 500 ft.——A mill is being erected at the Saratoga mine.——Cinnabar deposits in Copper Basin are to be developed.

CALIFORNIA

Amador County

It is reported that the Kennedy company has purchased the Zeila mine at Jackson for about $50,000. This property is said to contain a large quantity of ore, requiring modern equipment for profitable extraction.——The Bunker Hill output in July was $35,000 of which $13,000 was profit. The dividend absorbed $5000. The lower levels are opening well.

Butte County

A representative of the Luther Burbank Co. is at Oroville investigating the suitability of dredged areas for growing the firm's spineless cactus, used for feeding stock. Some of J. H. Leggett's land will be tried first.

Eldorado County

The Georgia Slide claims near Georgetown are being examined by M. L. Hurley of New York, and a lease has been secured by H. K. Montgomery until September.——The Rising Hope gravel mine has made its first shipment of gold after five years' work. G. W. Engelhardt is manager.

Inyo County

A report on the Cerro Gordo mine near Keeler has been made by Edward S. Spring. The property is in a comparatively inaccessible position, making haulage charges heavy. An aerial tramway 29,118 ft. long, costing about $50,000, from the mine ore-bins to those at the railroad at Keeler, is nearly

finished. L. D. Gordon is the present lessee, his lease expiring on September 18, 1915. The main vertical shaft is down 900 ft., with an incline winze 250 ft. below that depth. Faulting has been of frequent occurrence. The best ore occurs chiefly in limestone. At present only zinc ore is being extracted. Silver-lead ore also occurs. The Cerro Gordo Mines Co. also controls the adjacent Newsboy claims. Over 50,000 tons of slag from former smelting operations is a large asset.

Nevada County

At the Cassidy mine, adjoining the Empire, nine miners under W. P. Martin, averaged 11 ft. per day in hard ground for the past four weeks.

Relatives of two of the men killed in the Columbia mine near Washington some time ago are to receive a total of $4150 each. The other case has not been settled yet.——Hawke Bros. are constructing a small dredge on Deer creek, near Nevada City.

Placer County

The Federal Drift Co. is sinking and driving under the town of Dutch Flat, in charge of W. T. Watson. The district is showing increased activity.——The Rossier silver-lead mine near Colfax is being examined.——Thirty-five men are working at the Ralston mine.

Plumas County

The State Railroad Commission has granted permission to the Great Western Power Co., whose plant is on the Feather river, to construct a transmissiou-line to the Engels copper mine and mill.

San Diego County

In the Chamber of Mines and Oil, Los Angeles, *Mining and Oil Bulletin* for July, tube-mill pebbles from this county are discussed by E. H. Schiek, who states that the pebbles gathered on the beach there are of good quality.

Sierra County

Speciman ore, worth about $10,000, was taken out of the Eldorado mine on Kanaka creek, below Alleghany, last week by Fessler Bros. and Armstrong Bros.——A good development is reported from the Twenty-one mine, adjoining the Tightner. ——At the Monarch and Cleveland mines, near Sierra City, 75 men are employed. Considerable work is under way. Ten stamps are dropping at the latter.

Tuolumne County

(Special Correspondence.)—At the old Santa Ysabel mine, just south of Jamestown, there has been a good deal of activity in the last two months. Twelve men are now working in the lease, and twelve are on the pay-roll of the Nyman Consolidated Mines Co. About 20 tons of good milling ore is being extracted from the lease each shift. The mill-bins are filled from the rich Mascot ores now being drawn from the 200 and 250-ft. levels from the main three-compartment shaft. Fifteen stamps are dropping and another five will be added as soon as the ore reserves are equal to 20-stamp capacity in the 40-stamp mill. About 500 tons are now in reserve in the Mascot stopes, and three machines are increasing this amount. Last year the Mascot vein was found on the 400-ft. level, showing 12 in. of excellent ore. A raise will soon be started on this shoot to connect with the 250-ft. level, and systematic extraction started. The property is fully equipped with 40 stamps, a 750-cu. ft. air-compressor, a 2000-ft. steam hoist, a 400-kw. substation for the operation of all equipment except the hoist. The work at the mines is under the direction of C. E. Shafer, who was formerly in charge of the Harvard mines.

Jamestown, July 29.

COLORADO

Clear Creek County

Cyanidation has been abandoned at the Hudson mill at Idaho Springs, amalgamation, concentration, and flotation now giving excellent results. S. P. Warren is in charge.

Eagle County

The Iron Mask, Rock Point, and Chief mines at Red Cliff have beeu purchased by the Empire Zinc Co. at a high price. The Eagle mill which is treating 120 tons daily, is included in the sale.——It is rumored that the American Zinc Co. is negotiating for zinc properties near Red Cliff.

Gilpin County

According to Robert Sayre, of Black Hawk, the Lake mine, which is operated through the Big Five tunnel at Idaho Springs, produced 16,507 tons of ore which yielded a net return from the smelters of $122,629. The mine is developing well, good ore being opened at 2300 ft. depth. Mosher and others have most of the miue on lease.——Lessees at the Gilpin Eureka are making good profits.

Gunnison County

Twenty four-horse teams are hauling iron-zinc ore from the Doctor mine 19 miles to the railway. A large lode has been opened.——The Denver City people are still unwatering their property.——The Brant company is installing machinery.

Lake County (Leadville)

At the Down-Town property the station at 470 ft. in the Penrose shaft is nearly complete. The Valley adit is in 1200 ft. into Prospect mountain. The ground is heavy, and timbering is difficult.——A large tonnage of ore continues to be shipped from the Ibex.——Lessees are re-opening the old Bartlett mine on Sugar Loaf.——Mining in the Lackawanna area is increasing.

Park County

Rich gold ore (about $100 per ton) that had been extracted from the London mine during last winter is now being shipped to smelters. Cripple Creek and Denver people are investigating properties nearby.

San Juan County

The Wilfley mill has started treating tailing from the lake near the Silver Lake plant. Flotation is part of the process. ——The Frisco mill is working again.——Development continues at the Golden Fleece, Syracuse, and several properties near Animas Forks.

IDAHO

Bonner County

Fire of unknown origin completely destroyed the mill of the Idaho-Continental mine, 26 miles from Porthill, on July 30, entailing a loss of $50,000. The plant was insured for $20,000. One hundred men were employed at the property. The president, A. Klockman, states that it will be re-built.

Shoshone County (Coeur d'Alene)

Dividends paid by Coeur d'Alene mines during July amounted to $1,124,490; the total this year to date is $2,849,098, exclusive of profits paid to owners of the Hercules mine. July payments were as follows: Interstate-Callahan, $575,000; Stewart, $309,-590; Bunker Hill & Sullivan, $81,750; Caledonia, $78,150; Hecla, $20,000, and Success, $60,000. Dividends for August are expected to greatly exceed those for auy previous month in the history of the region. The special declaration of Interstate-Callahan of $920,000 is expected to be followed by announcement of a liberal payment by several other dividend payers. The Hecla company announces that it will pay 7c. per share, or $70,000, monthly. Net earnings of the Interstate-Callahan in June were $675,000. Shipments of ore and concentrate amounted to 5400 tons.

On August 20 the Success company will pay 8c. per share, equal to $120,000. This makes $285,000 for the year, and $630,-000 to date. Many improvements are being made to the property.

It is rumored, apparently with some foundation, that the Hercules Mining Co. and the A. S. & R. Co. have agreed as to the smelting contract. The Hercules is to pay $16 per ton for freight and treatment, and the settlement rate is to be 90%

of the full New York price for 90% of the lead-content of the ore. As a further concession, it is said, the Smelting company has promised to keep Harry L. Day, one of the Hercules owners, as president of the Federal Mining Co., which is controlled by the Smelting company.

MICHIGAN

The Copper Country

In the first half of 1915 the Mohawk produced 7,410,393 lb. of copper. The average yield is about 18 lb. per ton of ore. This output is far ahead of previous periods. Costs were the lowest on record.——On July 31 the Wolverine and Mohawk companies paid their 1200 employees a 5% bonus.——Owing to a minor accident at the Allouez, the output in July was not quite 1,000,000 lb.——The daily ore production of the Calumet & Hecla is now over 11,000 tons.——During the financial year ended June 30, 1915, the Wolverine produced 7,350,866 lb. copper at about 8.5c. per pound, from 297,614 tons of ore. The June output was 637,346 lb.——Financial results are as follows:

	1915.	1914.
Revenue	$929,192	$484,081
Profit	318,201	81,075
Dividends	360,000	.....
Surplus	787,310	829,109

The *Daily Mining Gazette* estimates the copper output of the district in July as follows:

Mine.	Pounds.	Mine.	Pounds.
Calumet & Hecla	8,050,000	Mohawk	1,300,000
Quincy	2,000,000	Franklin	270,000
Copper Range	5,400,000	Centennial	280,000
Winona	200,000	Allouez	850,000
White Pine	450,000	Mass	500,000
Houghton	70,000	Superior	360,000
Tamarack	450,000	Hancock	175,000
Osceola	1,900,000	LaSalle	125,000
Ahmeek	2,300,000	Victoria	260,000
Wolverine	700,000		

MISSOURI

Jasper County

Production of the Missouri-Kansas-Oklahoma region during the last week of July was as follows: blende, 4885 tons; calamine, 328 tons; and lead, 573 tons. The average value was $90.91, $46.22, and $58.54 per ton, respectively, the total value being $492,809. For 31 weeks the total is $13,552,401, blende, accounting for $11,699,861.

St. Francois County

It is reported that in July the St. Joseph Lead Co.'s earnings were over $500,000. The large export contracts are resulting in big profits.

MONTANA

Silverbow County

During the second quarter of 1915 the Davis-Daly Copper Co. did 1697 ft. of work at 1400, 1700, 1900, and 2500 ft. Encouraging results were obtained at the lowest level. Low-grade ore from 1700 ft. has been mined at a profit. The output was 1422 tons of ore assaying 3.7% copper, and 6.4 oz. silver. The cash balance is $56,999. Assessments are coming in slowly.

Net earnings of the Butte-Ballaklava in July were about $37,000. The daily output is 250 tons of ore, containing 3.4% copper.

NEVADA

Churchill County

In the second quarter of 1915 the Nevada Hills company treated 16,410 tons of ore averaging $5.94 per ton. The tailing loss was 97c. per ton. The net profit was $17,105. Assets total $278,145.

Esmeralda County

The Florence mine produced 430 tons of $18 ore in July. This was extracted from the 'new' vein at 250 ft. north of the shaft of the old Florence Con. lease area. Owing to a fire at the Campbell & Kelly foundry at Tonopah, the new head-frame and equipment will be delayed about a month.

Humboldt County

The Willard district is proving to be more persistent, and prospects are good. A representative of an ore-treatment concern considers that there are large quantities of good milling ore. The Honey Bee adit is in 125 ft., cutting $25 to $40 ore. The Oddie-Malley-Cole lease cross-cut at 50 ft. depth is in good ore. Conditions at the Healey-Mayer-Borland, Sheepherder's Dream, Excelsior, Big Thing, Ruth, Finland, and the Fords are encouraging.

The Friedman adit, to cut the veins in Rochester hill at 1200 ft. depth, is being driven 12 ft. in two shifts. The adit is in 430 feet.

The Buckskin National company has purchased a hoist and compressor. Drifts from No. 2 level have opened the vein for over 1000 ft. in good ore. F. F. Bell is superintendent.

Lincoln County

Foundations for the 50-ton mill for the Yuba Leasing company are being prepared. The plant is expected to start by September 15.——Plans have been prepared for the new mill of the Amalgamated Pioche company. A Colorado smelting company will take the product. The output of ore last week was 300 tons.

Lyon County

The new 250-ton leaching-plant for the Nevada Douglas company is nearly complete. Work was started in September 1914. The mine is estimated to contain 550,000 tons of 3% copper ore. Recent development has added 30,000 tons averaging 5%.

Mineral County

(Special Correspondence.)—Active work continues at Rand, 15 miles east of Walker lake. At the Queen Regent Merger, part of the property has been leased. Shortly after this was let, 9 ft. of ore was cut, 7 ft. suitable for milling, the remainder for shipment. One carload assayed $58 per ton. The Golden Pen is showing rich ore. One lot was worth over $100, another $250, and another $400 per ton, while specimen ore is sent out by express. Higher up the hill a fine vein is being opened by an adit. The owners want $125,000 cash for the property.

Rand, August 7.

A carload of rich ore has been shipped by W. S. McRacken, T. W. Kenyon, and W. A. Woodruff from the Eagle mine. The shipment, which went to the Selby smelter, averaged 4.35 oz. gold and 2.76 oz. silver per ton. The Eagle is an old mine, 300 ft. deep, developed by an adit only, and recently re-opened.

It is reported that rich gold-silver ore has been discovered 25 miles east of Mina. Claim-jumpers have been busy.

Nye County

Six companies and several lessees at Tonopah last week produced 10,722 tons of ore worth $218,956.——At the old workings of the Midway 10 sets of lessees are producing from $25 to $100 ore.——Lessees at the Montana shipped 49 tons.——The Belmont dispatched 176,284 oz. bullion and 42 tons of concentrate from both mills, valued at $133,000.——The Jim Butler is developing on five levels each at the Desert Queen and Wandering Boy.——The West End shipped 70,256 oz. bullion.——At 540 ft. on the MacNamara vein in the Silver Top claim of the Tonopah company there is 10 to 12 ft. of mill ore. $40,000 of silver was sent away last week.——The Extension shipped 103,350 oz. bullion and 27 tons of concentrate, worth $68,500. ——Development continues at the Mizpah Extension, Halifax, North Star, Rescue-Eula, Buckeye-Belmont, Bonanza, Umatilla, Monarch Pittsburg, and Cash Boy.

NEW MEXICO

Grant County

The Chino Copper Co. reports as follows for the second quarter of 1915:

Results of operations.	Second quarter.	First quarter.
Material moved, cubic yards	1,208,360	834,158
Ore treated, tons	592,200	406,000
Average metal-content, per cent	2.38	2.19
Extraction, per cent	65.34	66.12
Copper output, pounds	18,455,502	11,732,508
Cost per pound of copper, cents	6.10	6.38
Net profit	$2,006,548	$890,638
Dividends paid	652,455	434,970
Surplus	$1,354,093	$455,668

The cost was the lowest since operations started.

UTAH

Juab County

According to the semi-annual report of the general manager of the Chief Consolidated at Tintic, Walter Fitch, development totaled 2629 ft. Ore shipments amounted to 11,865 tons worth $21.78 per ton. Charges were $10.65 per ton, and total profit $47,020. The year started with a balance of $115,713, and at July 1 there was $211,954 on hand.

The Tintic district shipped 165 cars of ore last week. Some encouraging work is being done at the Grand Central, Gold Chain, War Eagle, Yankee, and some claims in west Tintic.

Piute County

It is expected that the Mineral Products Co.'s plant at Marysvale will start in September. Only potash will be recovered from the alunite.

Salt Lake County

The Utah Copper Co. reports as follows for the second quarter of 1915:

Results of operations.	Second quarter.	First quarter.
Overburden removed, cubic yards	1,548,132	1,143,596
Ore treated, tons	2,215,159	1,396,341
Average metal-content, per cent	1.42	1.42
Extraction, per cent	64.85	....
Copper output, pounds	40,799,825	26,415,995
Cost per pound, cents	7.49	8.19
Net profit from production	$3,680,249	$1,691,728
Income from other companies, etc	732,050	475,688
Total profit	$4,412,299	$2,167,416
Dividends paid	1,624,490	1,218,367
Surplus	$2,787,809	$949,049

The Bingham & Garfield railway carried an average of 16,798 tons of ore per day, and 29.21 tons of other freight.

In the Journal of the Western Society of Engineers of Chicago, for June, the Bingham and Garfield railway, a short road with some unusual features, is described by H. C. Goodrich. The road is 25.93 miles long from the Utah Copper mine to the mills near Great Salt Lake, including long bridges and tunnels. Including sidings, etc., the total track was 102.08 miles. The rolling-stock consists of Mallet compound locomotives, switching engines, ore-cars, concentrate-cars, general cars, passenger-cars, wrecking-crane, etc. The greatest tonnage of ore handled in a day was 26,730 tons, also commercial freight and passengers. Forty cars of 56-ton capacity make up a train. The difference in elevation of the terminals is 1874 feet.

The Cardiff mine, in Big Cottonwood, is shipping over 100 tons of ore daily. Ninety-five men are employed.——The Alta Tunnel & Transportation Co. has arranged to sell the water flowing from its adit to the municipality of Salt Lake City. The present quantity is about 647,000 gal. per day. The adit is in 1400 ft., or about one-third.——The Alta Tiger company has purchased an interest in the Highland Chief ground in Little Cottonwood, and will be able to gain 500 ft. in opening its property.

Summit County

A 50 to 75-ton capacity Callow flotation-plant is to be installed at the Daly-Judge mill at Park City. This will save the zinc and lead being lost in the slime, and will result in an additional recovery of $50,000 per year. After leaving the mill the slime will be filter-pressed, then pass to a Dorr thickener and the flotation cells. The company is making good profits.

The Snake Creek tunnel was advanced 368 ft. in July, making a total of 12,000 ft. It should be finished, 14,000 ft., early in 1916.

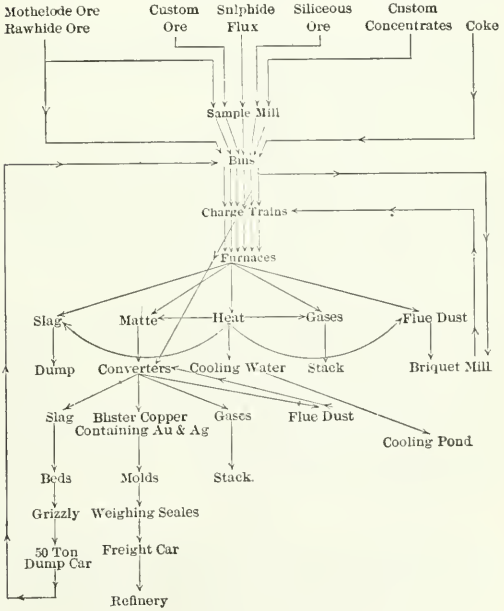
CANADA

British Columbia

At Grand Forks the Granby company has eight furnaces in blast. The output of copper for five months of 1915 was 6,057,249 lb. at Grand Forks, and 7,455,407 lb. at Anyox.

The Slocan district is more active than ever before, new mines being opened, and those idle for years being re-worked.

The high price of copper enables the British Columbia Copper



FLOW-SHEET OF B. C. COPPER CO.'S SMELTER AT GREENWOOD.

Co. to treat its low-grade ore profitably. The smelter at Greenwood has a capacity of 2000 tons per day. One furnace is now in blast.

The Silver Hoard Mining Co. is to erect a 50-ton mill using concentration by water and flotation.

Ontario

(Special Correspondence.)—It is reported that a new townsite is being planned at the gold camp of Sesekinika, 10 miles north of Swastika on the T. & N. O. railroad. The geological formation and the ores differ from the Porcupine area. The formation is generally andesite and diorite, while most of the

ores contain tellurium. The veins are narrow, but rich. Directors of the Dome are to consider the matter of declaring the initial dividend of the company. This is expected to be 5% quarterly. The estimated production for July is $130,000. ——It is expected that diamond-drilling will soon commence at the Preston East Dome which adjoins the Big Dome.—— The Buffalo company of Cobalt has been sampling the Teck-Hughes at Kirkland lake, on a basis of actual purchase of the property.——The rich ore of the Vipond recently cut between the 300 and 400-ft. levels is reported to be about $160 per ton. ——The annual report of the McIntyre shows the estimated ore reserves on March 15 to be 93,836 tons, worth $7.89 per ton, and broken ore in stopes 15,857 tons, worth $7.14 per ton. ——Efforts are being made to commence work at the West Dome in October.——The Ontario government last year sent a representative through the mining districts of the province in search of radio-active minerals. He was unsuccessful. Some of the ores of the Kirkland Lake and Goodfish districts are fonnd to be slightly radio-active, but not yet of commercial value.

It is reported that the Seneca Superior company at Cobalt has obtained a lease on the Gould Consolidated which adjoins it.——The old Wright mine on Lake Temiskaming may be worked again. This is probably the oldest silver mine in Canada, records and maps of the property dating back some 300 years. The ores contain galena.

Timmins, July 26.

YUKON

On July 23, No. 2 dredge of the Canadian Klondyke Co., which was being overhauled, resting on piles, suddenly slipped into the pond, killing one and injuring three others. This boat capsized at the end of last season.

MEXICO

American mine operators in northern Mexico interviewed Villa on August 11 regarding the conditions under which they are working. He wants all payments to his department in gold.

Exports of crude oil from Tampico to the United States during June totaled 864,208 bbl., against 684,824 bbl. in May.

CHIHUAHUA

(Special Correspondence.)—The Concheno Mining Co., controlled by Corrigan, McKinney & Co. of Cleveland, Ohio, has started its 60-stamp mill and cyanide-plant at Concheño Distrito Rayon. The equipment includes concentrators, sand-leaching vats, tube-mill, continuous agitation of slime, Butters filters, zinc-boxes, three 300-kw. generators driven by high-speed Ball engines, steam and electric hoist and compressor, also a turbine auxiliary. H. W. Edmondson is general superintendent, and Donald B. Gillies general manager.

Chihuahua, July 15.

SONORA

The Moctezuma mine and mill at Nacozari resumed work last week, after nearly a month's shut-down. Bridges on the railroad have been temporarily repaired, and trains of coal, oil, food, and other supplies have been received. Several hundred cars of copper concentrate awaits shipment to the Copper Queen smelter at Douglas.

KOREA

The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for July at the Suan mill:

Ore treated, tons	6270
Mill working days	26½
Recovery, bullion	$45,785
Recovery, concentrates	$30,680
Total	$76,465
Operating expenses	$27,500
Net earnings	$48,965

PERSONAL

H. H. WEBB is at Santa Barbara.

ROBERT B. TODD was in Tonopah last week.

C. S. HERZIG was at Salt Lake City last week.

F. E. MARCY was here on August 10 from Salt Lake City.

P. T. BRUHL has arrived here from Collahuasi, in Chile.

JOHN W. MERCER left San Francisco for New York on August 12.

ROBERT VAUGHAN and W. D. ROGERS are returning to Cinco Minas, in Jalisco.

H. S. DENNY is in charge of the reconstruction of a high explosive factory in Wales.

GELASIO CAETANI has obtained a commission in the Aviation Corps of the Italian army.

FRANK H. PROBERT announces his change of address to the Hobart building, San Francisco.

PHILIP R. HUDSON and C. FIELD, both of the Guanajuato Development Co., were in San Francisco this week.

CHARLES E. LOCKE, Professor of Mining in the Massachusetts Institute of Technology, is leaving San Francisco today.

ROBERT S. LEWIS, Associate Professor of Mining in the University of Utah is at his home near Palo Alto, California.

ANDREW C. LAWSON, Professor of Geology, has been appointed dean of the College of Mining in the University of California.

F. F. HEYDENFELDT, superintendent of the Tonopah Mining Co.'s plant at Millers, has been spending a month in California.

CHARLES W. NEWTON, superintendent of the Con. Interstate-Callahan Mining Co. of Wallace, Idaho, spent several days in Butte recently.

FRANK MANSON, manager of the Western Ore Purchasing Co., was recently elected a director of the Goldfield Consolidated Mines Company.

WALTER SCOTT WEEKS, recently instructor in Harvard University, has been appointed Associate Professor of Mining in the University of California.

CHARLES E. VAN BARNEVELD, at present chief of the Department of Mines and Metallurgy at the Exposition, has been appointed Acting Professor of Mining in the University of California.

W. H. BLACKBURN, general manager of the Tonopah Mining Co., and J. G. KIRCHEN of the Tonopah Extension, were at Reno last week attending a meeting of the Nevada Mine Operators Association.

MORTON WEBBER, of New York, who obtained a commission in the Royal Field Artillery after the outbreak of war, was recently wounded in France. He has now recovered and has joined the British Expeditionary Force at the Dardanelles.

Schools and Societies

The NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES opens at New York on September 20.

The Seattle Association of Members of the AMERICAN SOCIETY OF CIVIL ENGINEERS met on July 26.

A new mining building to cost $215,000 has been given to the MASSACHUSETTS INSTITUTE OF TECHNOLOGY by several of its graduates.

The UNIVERSITY OF NEVADA at Reno, has issued its catalogue for 1914-1915, including announcements for 1915-1916. The publication covers 238 pages. The new year commences on September 1. Full details are given regarding admission, courses, and degrees.

The MICHIGAN COLLEGE OF MINES has issued its year book for 1914-1915, with announcement of courses for 1915-1916. It consists of 116 pages, and five tables showing time devoted to subjects, and three good maps of the region.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, August 12.

Antimony	35 —35¾
Electrolytic copper	20½—20¾
Pig lead	4.75— 5.70
Quicksilver (per flask)	$95
Spelter	23 —23¼
Tin	39
Zinc-dust, 100-kg. zinc-lined cases	No quote

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, August 12.—Copper is weak; the only market in lead is at concessions; spelter has practically no market.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Aug. 5	18.25	June 30	20.00
" 6	18.00	July 7	19.75
" 7	18.00	" 14	19.50
" 8 Sunday		" 21	19.04
" 9	17.85	" 28	18.62
" 10	17.75	Aug. 4	18.27
" 11	17.75	" 11	17.94

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended July 14 totaled 11,352,552 lb., worth $2,181,114. Of this, France got 7,492,788; Russia, 1,905,316; England, 1,308,704; Australia 263,621; Italy, 187,556; and Holland, 113,402 lb. Imports of all kinds totaled 2,861,770 lb., valued at $430,064. Canada sent 2,469,970 lb., and Japan 391,022 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug. 5	47.00	June 30	48.40
" 6	47.12	July 7	48.10
" 7	47.12	" 14	47.56
" 8 Sunday		" 21	47.47
" 9	47 37	" 28	47.29
" 10	47.75	Aug. 4	47.08
" 11	47.25	" 11	47.27

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec.	49.27	....

On August 7 about 270,000 oz. left San Francisco for China. Exports of silver from this port in July were worth $1,097,200, or, say, 2,250,000 oz. In the last week of July Cobalt mines dispatched 527,442 oz. The total from these for seven months is 5,068,043 oz. London will store bullion and make advances on it; while American smelters will take all they can get at New York rates, and settle in full. Exports from London to the Orient for the period to July 21 were £1,457,000 less, say, 15,000,000 oz., than in the same time of last year. London stocks are about 20,000,000 oz. The dominant factor of prices in London is the restricted amount of selling from America, which offsets the sluggish disposition of buyers. India and China have operated little. The main support comes from the Continent.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July 14	95.00	July 28	95.00
" 21	95.00	Aug. 4	95.00
		" 11	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Aug. 5	5.00	June 30	5.55
" 6	5.00	July 7	5.75
" 7	5.00	" 14	5.71
" 8 Sunday		" 21	5.58
" 9	4.75	" 28	5.50
" 10	4.50	Aug. 4	5.12
" 11	4.50	" 11	4.79

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Aug. 5	16.50	June 30	20.58
" 6	16.00	July 7	22.10
" 7	15.50	" 14	22.26
" 8 Sunday		" 21	20.33
" 9	14.25	" 28	18.96
" 10	14.25	Aug. 4	17.79
" 11	14.25	" 11	15.12

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39 76	37.23	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On August 11 tin was firm at 34 87 to 35.37 cents. The Vulcan Detinning Co. reports that its sales for the half-year totaled $369,695, and net profit, $41,715. In the second quarter sales were $34,000 less than in that period of 1914.

ANTIMONY

Demand is quiet, but Chinese spot is being offered freely. Chinese and Japanese grades still continue to be quoted at 35.25 to 36.25c., while special brands are nominal at 44 to 46 cents.

The Nevada Consolidated reports as follows for the second quarter of 1915, compared with the first quarter:

Overburden moved, cubic yards	754,649	.....
Ore treated, tons	849,155	564,834
Average copper-content, per cent	1 40	1.49
Metal produced, pounds	15,106,920	10,815,681
Profit	$1,364,093	$615,818
Dividend	749,796	749,796
Surplus	$614,297	.....

Eastern Metal Market

New York, August 6.

Prices of all metals in this market are on the down grade, with the exception of copper. While the quotation for electrolytic has remained steady at 18.25c., considerable metal has been offered by second-hands at a lower figure. None of the plants in this vicinity making ammunition are having any trouble with their machinist employees, although there are a number of rumors that one such plant and two who have subcontracts will be closed shortly. One manufacturer of machine-tools required by projectile-factories has a strike bothering him; the idea of the labor unions being to cripple the new plants that are entering the war-material field by cutting off their source of machinery supplies.

After being in a rut for months, pig-iron has started in the past week on what promises to be an important movement. Prices in all districts have advanced, and the sudden appearance of inquiry from many sources indicates an effort on the part of consumers to forestall a long-delayed rise. Pig-iron output is crowding close up to high-record figures on account of the demand for steel. The July production was 2,563,420 tons, or 82,691 tons per day, against 2,380,827 tons in June, or 79,361 tons per day. The steel companies are now close to their maximum pig-iron capacity. They made 62,895 tons daily in July, or 3900 tons more than in June. Production is now at the rate of 32,000,000 tons per year, against 18,000,000 tons on January 1. Rolling-billets are now quoted at $30 and higher in eastern Pennsylvania. This makes this class of semi-finished steel higher than some finished products.

ZINC

Prices have declined all the week, but the bottom does not seem to have been reached as yet. There is no demand for the metal, and with continued production at a high rate, further reductions in the price are not improbable. Dealers are anxious to dispose of their stocks, but very little has been sold for the last half, although the price for fourth-quarter delivery is 15 to 16c. At present the market is lower than it was after the reaction following the high June price of 26½c. Spot metal is difficult to obtain. Brass-mill special has declined, and is now quoted all the way from 18 up to 23c., compared with 30c. last week. Prices, while entirely nominal, have receded from 18.12c. a week ago, to 17.25c. yesterday, when the price fell to 16.50c. The exports for July which were the lowest since last August and about half those for June, amounted to only 4483 tons. For August only 200 tons has been sent abroad up to and including August the 5th.

COPPER

In spite of a market that has been dull for almost a week, producers have, nevertheless, been able to keep the price of electrolytic steady at 18.25c. While there has been considerable talk of impending transactions, it has not gone any further. There is no business, and consumers appear to be waiting for a further decline in prices, although the producers look forward to a revival of demand from domestic interests working on war business. For that reason they are not disposed to lower the 18.25c. quotation, but consumers appear to be well covered. Second-hands are reported as offering unlimited quantities at 18c., consequently there is little prospect that prices will be sustained. About all the business that has been done in the past three weeks has been limited to a few small sales. Russian and Italian munition contracts calling for 50,000 tons of copper are reported in the daily papers as being closed, but this cannot be confirmed. The quotation on Lake copper is nominally 21c. There has been no business to test the firmness of this price, but sellers are generally reported to be willing to meet buyers. The exports for the month of July were 17,308 tons, or about half those of July, 1914. The exports for the first five days of August amounted to 346 tons.

The following table shows the copper exports from Atlantic ports during July in gross tons:

Destination.		Destination.	
United Kingdom	3,865	Norway and Sweden	333
France	6,000	Russia	2,950
Holland	336	China and Japan	....
Italy	3,398	Sundries	376
Denmark	50		
		Total	17,308

Ingots account for 2918; pigs, 1125; bars, 9892; plates, 1453; cakes, 135; and rods and wire, 1785 tons.

With a record production of 27,000,000 lb. of copper in the Houghton district in July, and 28,000,000 lb. assured for August, if everything works out as planned, the output is breaking all records. The bulk of the copper produced is sold up to September, and in some cases to October.

LEAD

The difficulty in absorbing re-sale lots mentioned last week has been intensified. Demand has not improved in the past week; in fact, the reverse is true. The situation is dominated by re-sale lots which continue to make their appearance. Although consumers are continuing to use large quantities of this metal, they are evidently overstocked. In the past week the price of the leading interest has been reduced twice, thus proving that the belief of the producers that consumers would soon enter the market was wrong. On July 30, the price was reduced to 5.50c., New York, and on Monday, there was another decline of ¼c. In both cases, outsiders went still lower, going to 5c. on Tuesday. On Thursday holders offered the metal at 4.75c., but buyers were not attracted and the sales which took place later in the day were at 4.50c. Consumers are not in any hurry to cover future requirements, and it is understood that on contracts covering shipments over the remainder of the year the price of 4.75c. is being shaded. July exports were 2458 tons, and on August 4 a shipment of 20 tons was made to Batavia, Dutch East Indies, which is all that has been exported so far this month.

TIN

Although the tin consumption for the year is predicted to be larger than 1914, based upon July deliveries of 5300 tons, 4700 at the Atlantic seaboard and 600 on the Pacific coast, the market is quiet, and consumers are not in the market at present prices. On Wednesday the price was 35.50c., New York, and following the arrival the next day of 1505 tons, the price dropped to 34.75c. While consumers are well covered for several months to come, it is believed that should prices recede further they will enter the market. Future positions are not receiving much attention. There was some demand for futures a few days ago, but it is doubtful whether any business was placed or not. Speculation is entirely absent. The July deliveries of 5300 tons compare with 3900 tons for the corresponding month of 1914. For the three months ended July 31, 1915, the deliveries were 14,800 tons, against 11,350 tons for the same period last year. Stocks on hand August 1 were 991 tons, and the total afloat at the close of July was 12,070 tons, against 11,166 tons in June and 5519 tons on July 31, 1914. The total visible supply on that date was 16,084 tons. There was a sharp break in the London market on Thursday, Straits spot declining £2 10s. to £154 10s. against £160 10s. on July 29. The arrivals August 1 to 5, inclusive, were 1600 tons, and there were 6100 tons afloat on that day. About 200 tons of this is due to arrive within the next week.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Pipes at the Exposition

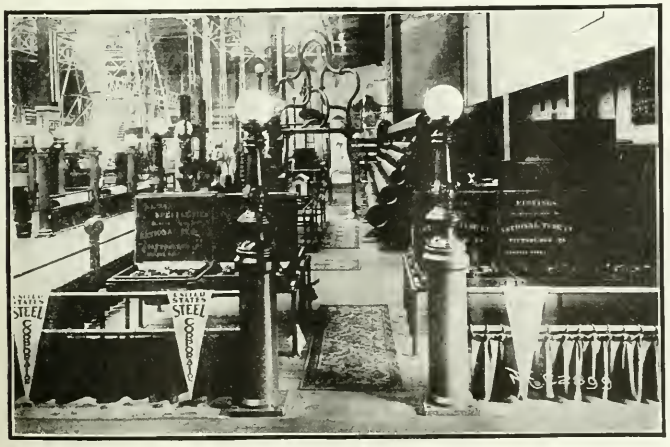
In the Palace of Mines and Metallurgy at the Exposition the U. S. Steel Corporation's exhibit covers a large area. Its subsidiary, the National Tube Co. of Pittsburg, has approximately 6000 sq. ft.

This company manufactures three closely related, and yet distinctly different, lines of products, and the exhibit naturally divides itself into the following sections, namely, (1) 'National' pipe and allied tubular products; (2) 'Kewanee' specialties, fittings, etc.; (3) 'Shelby' seamless tubing and cylinders. The display of National pipe and allied products is the largest of the three sections. This is as it should be, inasmuch as National Tube Co. has an annual capacity exceeding 1,250,000 tons of tubular products.

Entering the main section, the visitor walks through a large arch, 15 ft. high, made of miscellaneous bends of 4-in. National pipe. Immediately behind this is a massive rack, on which are displayed the various types of National pipe used in the oil-fields of the world. Capping this rack, is the largest and longest individual length of lap-welded wrought pipe ever made in America, consisting of one length of 20-in. O.D. National pipe, 39 ft. 6 in. long. This double length of pipe, was welded at the National works of the company at McKeesport, Pennsylvania.

The right-hand portion of the main booth is devoted to the display of Kewanee specialties, including the Kewanee union, 'NTC' re-grinding valve, brass fittings, cocks and valves, malleable and cast iron and wrought fittings. Probably the most commanding feature of this section is the colossal model, made to exact proportions, of a two-inch octagon Kewanee union. An eighth section has been cut from one side of the model in order to show in cross-section the Kewanee patented principle, which consists of (a) brass to iron thread connection, no corrosion, (b) brass to iron ball-joint seat, no gasket, (c) 125 lb. compressed air test under water, no defective fittings, and (d) solid, three-piece construction, no inserted parts. Nearby is a working model of a testing machine, designed and used to give each Kewanee union a 125-lb. compressed air test under water, thereby protecting the consumer against the possibility of receiving defective unions. A complete line of Kewanee specialties and fittings is neatly displayed on a multiplex, swinging-leaf, exhibit rack.

Across the aisle from the Kewanee section, in a separate booth, is the exhibit of Shelby seamless tubing and cylinders. Perhaps the most unique feature of this exhibit is a set of furniture, consisting of six chairs, one settle, and a table, made entirely of Shelby seamless tubing. The method of manufacturing seamless tubing from a square, flat plate, known as the 'cupping' process, is clearly explained in an exhibit which shows the various steps from flat to finished cylinders or tubes.



NATIONAL TUBE CO.'S EXHIBIT AT THE EXPOSITION.

Scientific Instruments at the Exposition

Among the many instructive booths in the Palace of Liberal Arts is that of the Bausch & Lomb Optical Co., Rochester, New York, and San Francisco. This firm supplied the Exposition with a large number of parabolic searchlight mirrors for night illumination. There are over 700 of them, and there are 48 searchlights 36-in. diameter. Samples of these are on view in the booth.

The engineering instruments shown comprise transits, levels, theodolites, tachymeters, and alidades. As might be expected from the advancement in all scientific apparatus, include novel features which appeal to engineers, surveyors, and architects. There is the inner focusing device in the telescope, by which the focus is adjusted without the lengthening or shortening of the tube, assuring practically permanent collimation adjustment, water and dust-proof conditions, and equilibrium of telescope. There is also the tubular compass-needle which is lighter and consequently of greater sensibility. The graduations are marked by great precision, and these instruments are claimed to have received a high reputation for accuracy, advanced design and durability.

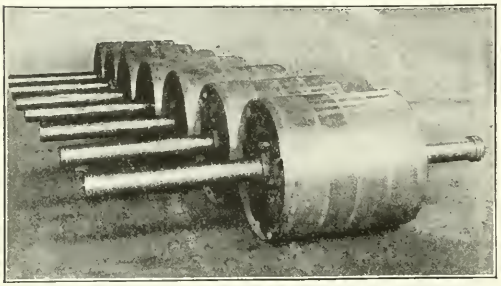
The 4½-in. tachymeter mountain and mining instruments are especially interesting. The water and dust-proof conditions, both as regards the telescope (due to the introduction of the interior-focusing system) and the mechanical construction of the plates, vernier-windows, compass-box, and vertical-circle guard, are considerations of the highest importance. The one piece U-shaped standard permits plunging the telescope at either end and assures the required stability and permanency so essential in a mining transit. A new manual of great value to the engineer will shortly come from the press, and will undoubtedly be highly appreciated by the users of engineering instruments, as the technical experts of this firm enjoy a high reputation among the profession. The firm has been awarded the Grand Prix at the Exposition.

Range-finders and periscopes naturally attract considerable notice at present. Bausch & Lomb make them up to 40-ft. long. Pamphlets distributed describe the range-finder, exophthalmometer, inter-

pupillary gauge, lens comparator, spectrum projector, keratometer, and the large Gullstrand phthalmoscope.

Magnetic-Separator Pulleys

The importance of removing 'tramp-iron' from material about to be delivered to crushers or pulverizers is recognized in modern plants. It is practically impossible to keep broken drills, coupling-pins, and other similar material out of ore and rock to be reduced. Those experienced in the operation of



MAGNETIC-SEPARATOR PULLEYS.

crushing plants know what costly and vexatious delays are caused by the presence of tramp material. Magnets have been sucessfully used. The magnetic-separator pulleys shown in the photograph were recently sent to the Washoe reduction works of the Anaconda company from the Cutler-Hammer Clutch Co., Milwaukee.

Wood Pipes and Tanks at the Exposition

From the Redwood Manufacturers Co.'s plant at Pittsburg, Contra Costa county, California, have been displayed in the Machinery, Mines, California, and other buildings at the Exposition a lot of interesting products. In the first named is a 17,000-gal. capacity Remco tank connected with 12-in. machine-banded Remco pipe and a 80-hp. Bessemer engine and 12-in. Advance pump, 5000 gal. of water per minute being pumped through the 12-in. redwood stave-pipe at a velocity of 11 ft. per second; samples of Remco machine-banded pipe of standard make in various diameters from 2 to 24 in.; samples of Remco continuous-stave redwood pipe as erected in the field; samples of Remco machine-banded pipe wound with copper wire, furnished where acid or strong alkaline solutions are used; a section of 18-in. Remco continuous-stave pipe taken from the main flow-line of the city of Logan, Utah, in June 1914. This pipe-line, from which this piece was cut, was installed by the firm in 1892, and has been in continuous service for 23 years.

Outside of the Machinery building is the 50-ft. Remco tower, surmounted by 30,000-gal. capacity Remco redwood tank, and supplied by 1500 ft. of 6-in. Remco machine-banded redwood stave-pipe. The pipe runs underground from San Francisco bay, and salt water is pumped through it and into the tank, against a 75-ft. head. This exhibit supplies the water for the cooling system in the building.

In the Mines building are three Remco redwood tanks and two towers exhibited by the firm in connection with the L. C. Trent Engineering Co. These tanks are in actual service, containing machinery and holding cyanide solutions.

Much of the sewer and drainage-pipe in the Exposition grounds are of the Remco brand. This is made either as continuous-stave or machine-banded. The former is made of redwood staves averaging 14 ft. long; the latter in sections 8 to 20 ft. long, and shipped ready to be laid.

Commercial Paragraphs

The JANTZ & LEIST ELECTRIC CO., of Cincinnati, Ohio, sends us photographs of its generators for all purposes.

A directory (133 pages) of piston-ring sizes has been published by the BURD HIGH COMPRESSION RING CO., of Rockford, Illinois.

A large proportion of break-downs in electric plants are due to improper operation of commutators and brushes. Graphite brushes are designed to reduce these troubles, according to the JOSEPH DIXON CRUCIBLE CO., New Jersey.

A new pipe and nut wrench is being manufactured by the HAYWARD WRENCH CO., 700 Cass avenue, St. Louis, Missouri. The tool is said to be the only automatic-combination, self-adjusting pipe, nut, and ratchet wrench on the market.

The WOOD DRILL WORKS, of Paterson, New Jersey, manufacturer of rock-drills, mining, tunneling, and quarrying machinery, has issued a useful catalogue on its drills. Details are given on every part of the machine, hose, and prices.

A new method of recording the cost of various operating conveyor-belts has been worked out by the B. F. GOODRICH CO., of Akron, Ohio, in the interest of all belt users. A record-card of explanation will be mailed by the firm on request.

On July 16, the U. S. Bureau of Mines approved for safety, practicability and efficiency in general service the miners' portable electric cap-lamp known as the 'Manlite No. 8,' manufactured by the MANNESMANN LIGHT COMPANY OF AMERICA, 331 Fourth avenue, New York.

The MORSE BROS. MACHINERY & SUPPLY CO., of Denver has recently installed a complete flotation testing-plant in its Denver store-room. The use of the plant is offered free to those wishing to make their own tests and experiments along this line. Competent assistance is also given to those desiring it, and free preliminary tests will be made on any ores or tailing sent in. A number of the recent flotation installations in Colorado have had their inception at this complete plant. The firm recently shipped seven carloads of machine-tools to various manufacturers in the East engaged in war-contracts. Most of the equipment was turret and engine-lathes.

Catalogue F of the DE LAVAL STEAM TURBINE CO., Trenton, New Jersey, in 64 pages describes and illustrates its centrifugal blowers and compressors. Many advantages are claimed for these types of machines which are used for the economical handling of air at all pressures from 5-in. water-column to 125 lb. per sq. in., single-stage and multi-stage compressors arranged for steam-turbine, motor, and belt-drive. Laws of compression, design, construction, tests, influence of blade shape, power-limiting characteristic, head-delivery characteristic, uses of the single and multi-stage blowers, and other products of the firm are discussed in an interesting manner. At the Swedish pavilion at the Exposition at San Francisco, De Laval turbines are shown as used for various plants.

The HUMPHREY internal combustion pump as installed at Chingford, London, England, with a daily capacity of 180,000,000 gal., and that in Egypt with a capacity of 792,000,000 gal., was discussed in the PRESS of June 28, 1913, and July 18, 1914. A 66-in. pump is to be installed on the Bedell-Moore estate, near Del Rio, Texas, where it will be used for irrigation purposes, and was manufactured by the HUMPHREY GAS PUMP CO., of Syracuse, New York. The pump, with the 'play-pipe,' takes the form of a short-legged V, the apex of the V, or base of the pump, being firmly bedded in the concrete base of the pump well, while the upper end of the play-pipe comes through the bottom of a concrete surge tank, from which the water is delivered to the main outlet channel. Gas will be supplied by a 300-hp. Akerlund down-draft producer, using either soft coal or mesquite wood, the latter being found on the land. The operating floor of the plant is just about low water-level of the Rio Grande river.

EDITORIAL

T. A. RICKARD - Editor

GOLD is coming to San Francisco from Australia and shipments of South African gold are on their way to New York.

WITH the pound sterling at $4.64 and the French franc at 17c., the eagle on the dollar may be forgiven if he screams even without being pinched.

PUNNING phrases are becoming common in serious discussions. "Has regulation regulated?" says one. "Is the efficiency engineer efficient?" asks another. Such begging of the question under guise of cheap wit detracts from the seriousness of the subject and can do no good. It repels the reader.

BUTTE & SUPERIOR, the first American mine to figure in flotation litigation, made an operating profit of $2,107,153 in the quarter ending on June 30 last. This is equal to $7.74 per share on the 272,018 shares issued. The company is producing zinc at the rate of 127,000,000 lb. per annum.

GROWTH of optimism is manifest all over the country. Crops, general trade conditions, and the relations of the Government with the belligerents in Europe all contribute to a cheerful tone. The steel industry is expanding splendidly, in response to foreign buying, war orders, and domestic consumption. Foreign exchange is abnormally low.

ON December 16 the Mining and Metallurgical Society will hold a special meeting at Washington for the particular purpose of calling the attention of Congress and the administration to the need for a revision of the mining law. It is important that an influential attendance should be secured and that the Pacific Coast mineral region should be well represented.

PATENTS are given two pages in this issue. We aim to record the most interesting of the metallurgical patents granted in the United States. Previous excerpts appeared on July 17. On this occasion, it will be noted that Salt Lake City is prominent as the address of several patentees. We are not surprised, for in the city by the saline strand are many energetic and resourceful engineers.

SOMEBODY at Cobalt has sent us a local paper in which a glossary of mining terms is given. The conspirator has marked the definition of 'ore:' this reads "Compound of metals with oxygen, sulphur or arsenic, etc." He expects a rise—not a 'raise.' We refuse to add to the belligerency of the times, for we want peace, with honor. Therefore we rest content with expressing a high appreciation of the "etc," *that* gives an artistic touch to the definition, for it includes things in the air, on the earth, in the waters under the earth; indeed it renders all other definitions supererogatory.

FLOTATION by froth is being used in the mills of the south-east Missouri lead region, which includes the St. Joe, Doe Run, and Bonne Terre districts. The process is applied to the slime, or classifier-overflow. No question of royalty has arisen as yet. Seven mills crushing from 2000 to 4500 tons per day are involved, the modification of practice having been outlined for the local mill-men by Mr. H. A. Guess from his work in the Federal mill.

WE are in receipt of the first issue of *Teniente Topics*, a magazine published by the staff of the Braden Copper Company, in Chile. The name is derived from the fact that the lode was discovered by a fugitive lieutenant or *teniente*. We note also that the smelter settlement formerly called Molino has been re-named Sewell, in memory of the late Barton Sewell, the former president of the company. This first issue is excellent. It contains a historical account of the enterprise by its founder, Mr. William Braden, and an introductory article by Mr. S. S. Sorensen, the present general manager for the company, who was formerly with the Nevada Consolidated Copper Company. Descriptions of the races, of tennis matches, of a hunting trip, and a Spanish supplement serve to give variety to the magazine. We congratulate the business manager of the publication, Mr. J. F. Pearce, superintendent of supplies, and the editors, Messrs. L. E. Grant and A. T. Wood.

SPELTER has dropped from 26 cents per pound on June 14 to 12¼c. on August 14, while copper has decreased in price during the two months from 20¼ to 17c. These declines are not surprising, having regard to the rapidity with which quotations were hoisted as soon as it was realized that much copper and zinc would be required for manufacturing munitions of war. A flood of buying orders followed. Since then purchases have been postponed in the expectation of cheaper metal, but a resumption of buying is supposed to be imminent. For the good of the mining industry we would like to see zinc firmly stationed at, say, 10 cents; for that price, if assured, would mean handsome profits to the producer without crippling allied industries, such as that of galvanizing. As for copper, the resumption of production at full scale by the chief producers in this country, together with the beginning of a magnificent

output at Chuquicamata by the Chile Copper Company, plus the rush of metal from Alaska, has caused production to exceed consumption. Copper at over 20 cents is unhealthy, for, apart from the uncertainty of the market position, it stimulates the exploitation of a lot of mines that on average prices cannot expect to be operated profitably. Most of us would be content to see copper firmly placed at 17 cents, rather than making violent fluctuations of 5 cents, up or down. In short, steady prices and a normal market are best in the long run.

MEXICAN affairs have not yet come to the point of decision. The Pan-American appeal to the factional leaders and to the people of Mexico was made public on August 14; if the "reasonable time" suggested as sufficient to enable those interested to arrange a conference be assumed to mean 10 days, we must wait until next week to know whether President Wilson's latest move is to prove successful. Although Carranza has exhibited no conciliatory spirit so far, it is hoped that he will defer to the sentiment of the country, which is supposed to be weary of the endless strife and brigandage. Villa, Zapata, and others appear willing to stop fighting. Meanwhile our local press has published a large number of scare dispatches of a most foolish sort, including talk of a threatened invasion of Texas by Mexican revolutionists, as if the whole history of the Rio Grande border did not ridicule such a suggestion. So far nothing serious has happened on the frontier except the irresponsible incursions of stray outlaws; these incidents have no political significance and the exaggeration of them is grossly misleading. The real test is yet to come. If the joint message of the United States and the South American republics is disregarded, then our Government will have to act, or be stultified. The South American governments will do nothing but give their approval to the further steps necessary; they will not participate in any naval or military measures. We hope that further action may not have to be of a military character, but if Carranza proves recalcitrant while the others are willing to compose their differences, then coercion may be necessary, in the form of another military occupation of Vera Cruz and the stationing of a garrison in Mexico City until such time as a stable government can be restored—as was done in Cuba. By this time the people of Mexico, and Pan-America, must realize that the United States has no sinister design on Mexico, for President Wilson has been forbearing almost to a fault and has shown repeatedly his earnest hope that intervention might be obviated.

Wanted: Criticism

In a recent bulletin of the Canadian Mining Institute there appears a vigorous letter from Mr. G. R. Mickle on the subject of 'Voluminous Pseudo-Scientific Rubbish.' The mere title is a call to arms; we like people who throw away their scabbards and hurl themselves into the fray with real joyousness. Of the making of books there is no end and much piffle is a weariness of the flesh. Mr. Mickle even attacks the U. S. Geological Survey and instances a particular report on 'Natural Gas in 1913,' which gives a large number of analyses, some trustworthy and others untrustworthy, so jumbled as to render the data as a whole worthless to a serious enquirer. Moreover, the compiler of this misleading information appears to have ignored a previous and valuable volume on this very subject published by the U. S. Bureau of Mines. In the first place, whether the matter criticized be pseudo-scientific or not, we may point to the waste of public money in publishing information on the same subject in two reports from two separate Government bureaus. Of course, this is due to the effort of each organization to prove its efficiency, in order that it may receive large appropriations from Congress. Efficiency ought to include co-ordination of effort. However, that is another subject; let us return to the idea of "voluminous pseudo-scientific rubbish." Undoubtedly the general use of the typewriter, the cheapness of paper and printing, the spread of education, and the love of publicity have joined in causing a deluge of inane verbosity. The amount of matter now published on technical subjects is so vast that no editor can even skim it; no professional man can begin to read even the part relating to his own specialty; no index has yet been devised that will enable him to lay hands on what he most requires, because no index is discriminating. Technical papers grow in size and number, without corresponding improvement in quality, because the facility for writing is far ahead of the faculty of criticism. Technical societies issue fat bulletins, diffuse and unedited. Government bureaus base their appeals for financial support largely on the bulkiness of their publications. As for the Geological Survey, which has done, and is doing, work recognized to be so good that no praise from us is necessary, it also is the victim of the voluminous; for every State and every mining centre demands one or more volumes, so portly and so elaborate that by the time they have emerged from the printer they may be out of date. Multiplicity, bigness, and pretentiousness mark the prevailing style in volumes, reports, bulletins, and papers. What is needed is criticism, such criticism as will illuminate the essential and drive the unessential into the outer darkness of extinction. Most of us had become impatient with the critics, sneering at them as the incapables that had learned to destroy because they had failed to create, we preferred the constructive to the destructive, we looked upon the 'knocker' as a nuisance. Thus we have done our best to expel the real enemy of verbose writing, the natural check on the multiplication of verbiage. Indeed we have become so good-natured and so undiscriminating that the critic feels his function, if not gone, to be so little used as to be best allowed to pass into atrophy or become ankylosed. The cure is to be more critical ourselves, refusing to be impressed with mere bulkiness or to become mentally dyspeptic on a diet of half-baked technology. One or two independent editors, a few courageous secretaries, and some discrimi-

nating committees on publication, backed by readers of technical periodicals and members of professional societies earnestly desirous of less quantity and more quality of literary output would achieve the purpose for which Mr. Mickle lowered his lance.

Should Directors Speculate?

In continuation of our comment last week, we suggest that the answer to this query hinges on the further question whether a director goes on the board, for example, of a mining company (1) to safeguard his own interest in the property, (2) to protect a small group, by whom he has been nominated to the office, or (3) to act as a trustee for all the shareholders. If he is on the board merely as a privileged speculator, then he may reply, as one director did, that "self-preservation is the first law of society." But it is a poor proverb that won't work both ways. The first law of society is to protect itself against larceny. In all business combinations the idea of loyal co-operation is implicit; this involves the subordination of self-interest to the general good of the enterprise. Even bandits recognize that they must hang together or else run the risk of hanging separately. Joking apart, loyalty is the first mark of a good businessman. Without it, no continuity of joint action is practicable. Does the feeling of loyalty on the part of a director extend from himself to the general body of shareholders? Obviously not in the case just quoted. That director is on the board to get an advantage, to which he, quite frankly, considers himself entitled. It is not worth while to discuss the question with him, but a wise shareholder will neither support him for re-election nor hold stock in any company in which he, the self-preserver, has a controlling voice. Next we come to the nominee who is on the board to protect, not the company as a whole, but the interest of a particular group. He has advanced from the egoistic point of view to the broader position of helping his friends. This seems a nicer sort of business, but in effect it is even more dangerous, for a man's sense of loyalty to his friends will allow him to do for them what he would not do for himself, and a group will employ tactics that any individual in the group might spurn. Morality is diminished by addition, paradoxical as it may seem. The public has often suffered severely from the manipulation incidental to group tactics in company affairs. But it cannot be helped, you say. In large affairs the capital is subscribed by groups, each of which expects representation on the directorate. Yes, but there are groups and groups. Some of them realize their obligations to minority shareholders. They are worthy of support and they are safe leaders to follow.

Finally, we come to the director that has the sense of trusteeship to all the shareholders. He is uncommon. If he is to become less rare, he must be cordially supported. By him, and through the confidence he engenders, it will be possible to get the public to contribute to corporate finance in mining enterprise. Even promoters and financiers are beginning to observe a higher code of conduct. We know a particularly clever and successful man of this type who makes it a rule not to deal—buy and sell at short intervals—in the shares of those companies for which he is a director, confining his in-and-out transactions to enterprises in which he holds no fiduciary position. If he wants to carry out a share-deal, he resigns from the directorate, so as to have his hands free. If directors could be inoculated with that idea, the atmosphere of mining would become less malarial.

Another director replied that he had "a perfect right to sell—provided he stopped selling when he had disposed of his stock. To sell short is to hurt the company. A director who took advantage of inside information to sell shares in his company that he does not own ought to go to jail for it." The less said about jail the better. The self-preserving directors would consider it bad form to use such language. But is it more heinous to sell shares you do not own than to buy shares for which you cannot pay—is a 'bull' or a 'bear' the more gentlemanly beast? The argument that it is more wicked to sell than to buy is untenable. If you grant the right to gamble in the shares of a concern in which a man is a trustee, you yield the whole position. Whether his operations are moderate or immoderate, becomes no longer your business, but his. The idea that a 'bull' helps his fellow-shareholders, by improving their market, and that a 'bear' spoils the property he owns in common with other shareholders, is to play fast and loose not only with morality but with logic. In either event the stock becomes valued at a fictitious price and innocent people are deceived. We have an inveterate idea that money should be made in mining by producing metals profitably and not by gambling with loaded dice.

Another director, the chairman of a large State institution, testifies that "a director is chosen primarily because of his standing in the community, his experience and judgment being expected to be of value to the corporation. He is not put upon the board because he has a large amount of stock and so should be given access to more information than he would have otherwise. In other words, he is chosen for the company's good, and not his own." Here we begin to see the dawn of a better day. Compared to the talk of some of his colleagues, this gentleman's opinions sound like the ideals of an Ultima Thule. Nor is he a lone voice in the wilderness, for Sir Thomas Shaughnessy, the president of the Canadian Pacific Railway, says: "It has been an understood thing from the beginning that no director should either speculate in stock or should take advantage of any information secured in consequence of his membership on the board. In all my experience there has never been an occasion to find fault with any member of the board for speculating in stock or for utilizing to his own advantage inside information that he possessed, and I have never found it necessary to ask any officer of the company to tender his resignation because he was engaged in affairs that were not consistent with his duties to the company." That is a notable utterance and fittingly brings the discussion to an end. The graphic curve of business ethics has taken a decided turn upward in railroad and other

industrial affairs. We do not doubt the existence of a similar tendency in mining. Our own retrospect of 30 years in the business of mining, as engineer and journalist, gives us strong hope of continued improvement in financial conduct. Further betterment lies in the crystallization of public opinion as regards the trusteeship of directors.

The New Metallurgy

In this issue we publish an interview with Mr. Charles Butters. We feel sure that it will interest our readers, particularly the many friends of Mr. Butters in various parts of the world. To the younger men it should be a delight to read how one of their recognized leaders utilized the experience of life to such manifest advantage. On its human side the story proves that the mistakes of a sagacious man are merely stepping-stones to success. It also affords a striking example of that intensely American characteristic: the willingness to scrap anything that is useless in order to make way for something that is useful. The enterprise and initiative of our metallurgical hero furnish a splendid example to youth; to older men his quick decisions seem like playing with fate. It is not too much to say that in his eagerness to learn and his daring to put thought into action, Mr. Butters is a fit exponent of the modern idea at its best. Leaving the human side of the story, we turn to the technical. From amalgamation to chlorination, from chlorination to cyanidation this eager seeker of applied knowledge has progressed. Now no longer young, he finds himself facing a new departure; a new process that promises to revolutionize the concentration of ores on a world-wide scale. Does he feel annoyed to have his personal experience with other processes seemingly set to one side? No, with all the joyousness of a keen student he enlarges his home-laboratory and organizes a staff for earnest research. Testing the slime and other mill-products from the mines in which he is financially interested, he ascertains the applicability of the flotation process. Meanwhile samples of ore are sent to him from widely separated localities and upon them also he tries the effects of flotation. A metallurgical vedette, he is determined to keep in the van of progress. To us, and to our readers, we feel assured, this episode is both interesting and significant.

The information given by him concerning flotation is timely. It will be noted that the experiments made at Berkeley are all done with alkaline solutions. This in itself is noteworthy, for the use of acid has been a prominent feature of earlier flotation processes, because the acid accentuated the selective adhesiveness of oil for metallic particles as compared with the earthy gangue-minerals. But the most interesting information given in the interview is that dealing with the flotation concentrate. So far, at the lead-zinc mines of Broken Hill and at the big American copper mines using the process, the question of treating the concentrate itself has been shelved, for a ready market was furnished by the smelters. In many isolated localities, in Mexico or the West, the reduction of the concentrate on the spot is advisable, if not imperative. As to this, Mr. Butters makes some suggestions.

Moreover, his frank acknowledgment of lack of knowledge concerning certain phases of the process is instructive. As a matter of fact, the technology of flotation thus far has been mainly developed in the wake of a peculiarly vindictive litigation. The Law is not a good teacher of science. Indeed, of the literature of the subject to date it can be said that nine-tenths of it is hopelessly vitiated by the prejudices of patentees, process-mongers, and litigants. Most of the men experienced in the flotation process are either tied to the company claiming a monopoly in the use of it, or they are in the employ of the companies that are contesting that monopoly. In consequence, the amount of reliable information available is small. The metallurgists who have been largely instrumental in developing the agitation-froth process are under orders not to write or talk, for fear that they may hurt the cause of their employers in law-suits now pending, and that have always been pending since flotation—whether by oil, gas, or froth—first became of any consequence. On the other hand the metallurgists and mill-men associated with those who are confessedly infringing the disputed patents are in no position to give the profession the benefit of their experience with such frankness as they—and we—would desire. Meanwhile, if the mining industry is not to suffer, we must all try to break this embargo on knowledge. The Mining and Scientific Press has done so lately—not without success. And without injury to anyone. Our aim is to be helpful to many and injurious to none. Our sympathy goes to the clever men, especially those connected with the Minerals Separation Company, that are unable to expound the technology of the process or win the distinction that comes to specialists in a branch of the art growing rapidly in importance. We sympathize likewise with those who are making preliminary tests with flotation on their own ore and find it difficult to get proper guidance. With the assistance of a few independent investigators, we shall hope to remedy that deficiency. It is the province of technical journalism to gather information where it can, for the general good, and serve as a clearing-house of ideas to the professional men scattered among these widely-separated localities where the metals are won from Nature. The least that we can do is the best that we can do. The need for information is urgent. At a time when the base metals are intensively demanded for warfare, and in preparation for a time when they will be in still greater demand for peaceful purposes, it is peculiarly unfortunate that a process of apparently such wide usefulness should be stifled in the ill-ventilated atmosphere of the law-courts. In our next issue we shall publish an article on flotation at Anaconda by Mr. E. P. Mathewson and in subsequent issues we shall make further efforts to give our readers the latest information on a process, that, as Mr. Butters says, "has started a new era in the concentration of ores."

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment

Preferential Flotation

The Editor:

Sir—Your issue of June 26 contains a paper by O. C. Ralston on 'Preferential Flotation.' Owing to the author having confined himself to a study of American patents, incorrect presentations of chronology have arisen. In particular, Mr. E. J. Horwood of the Broken Hill Proprietary suffers, for his invention of the fractional-roasting method is made to date three years later than that of Mr. H. A. Wentworth. It is due to Mr. Horwood to say that he had carried the process into practice some years before 1912. In fact he had published, in the early part of 1910, details of results obtained on a practical scale, articles appearing in both the *Engineering and Mining Journal* and *The Mining Magazine*. Moreover, he described the modification introduced for the purpose of obtaining an increased proportion of the silver in the lead concentrate in a paper read before the Australasian Institute of Mining Engineers in 1913.

EDWARD WALKER.

London, July 24.

[Wentworth obtained his United States patent on January 2, 1909, while Horwood's first patent in Australia is dated January 13, 1909. Mr. Walker's exception is well taken.—EDITOR.]

A Hypothetical Case

The Editor:

Sir—In view of the controversy in the PRESS and other technical papers regarding the scarcity of mines, etc., it would seem justifiable to discuss one phase of the cause bringing about the present effect, that has not yet appeared in print.

As the owner of a shipping property I was reviewing in my mind one evening, while indulging in a fragrant havana, the future developments contemplated, based on present knowledge and future possibilities. During this day-dream, visitors, who introduced themselves as experts, interrupted me with a desire to know at what value I held the mine? On the impulse of the moment I replied "One million." They then requested that they be allowed to examine and sample the property.

Mr. Smith was spokesman for the party and his sublime seriousness impressed me. Regaining my senses, I asked him why he wanted to buy the mine? He answered "For investment." "Well," I said, "I also am an expert looking for investment and if the mine is worth a million to you, it certainly is worth that much to me, so why should I sell it?" "In fact," I added, "I could only have two objects in view: One being to take advantage of you because you over-estimate the value, by assuming that you can see unreasonable further possibilities, or, because I have no faith in my system of valuation. Being honest and reliable I have placed the true valuation according to the highest engineering standard, then how can you expect to realize on this investment?" Possibly some of the experts can answer.

MINE-OWNER.

Goldfield, August 10.

[Persons—particularly engineers—who buy mines "for investment" are deservedly regarded with suspicion. A mine is a speculation—a good or a bad one, according to luck and skill, particularly luck. Probably Mr. Mine-Owner would have been ahead of the game if the 'expert' had advised the purchase of the claim for that iridescent million.—EDITOR.]

Platinum Assaying at the Boss Mine

The Editor:

Sir—The article by F. A. Crampton on this subject is timely and it is to be hoped that it will be productive of profitable discussion. To that end I wish to make some remarks, based on memory, since my experience in platinum assaying dates back ten years and the notes I made during that period are not available at the time of writing.

Mr. Crampton draws attention to the discrepant results obtained by different assayers. I quite agree with all he says as to the difficulties of the analysis and the unfamiliarity of the average assayer with the necessary manipulations. But it must also be remembered that the platinum is presumably present in this ore in metallic form (as indicated, though not definitely stated, by Adolph Knopf in Bulletin 620-A of the United States Geological Survey) and all assays of material containing metallics are characterized by annoying discrepancies. This factor will persist in spite of improved technique on the part of the assayer. It is worth noting that in this ore, as in that of the Rambler mine, Wyoming, the amount of palladium present exceeds the platinum. No one knows in what form the palladium exists. Some ten years ago I expended much labor in an effort to separate and identify the palladium mineral in the Rambler ore, but without success, as I was unable to find any solvent that would attack the other constituents without dissolving the palladium mineral.

An important factor in the analysis of the Boss ore is that, aside from a little iridium, it seems to contain no other metal of this group. It is this that makes the simplification of procedure suggested by Mr. Crampton a possibility. The two methods given by Ricketts and Miller are not 'standard' ones; they are the methods devised by the late Dr. Miller to treat the materials he was called upon to analyze. When I was assayer for the Orford Copper Co., and had to make regular analyses on the precious metal residues from the Sudbury anode slimes, containing almost every metal of the platinum group, I used a method that was a legacy from my predecessor. It was even more complicated than the method described by Mylius and Mazzuchelli* and took about ten days' time to complete. I would have been glad to employ a simpler method, but it is a chemical impossibility to separate all these elements without going through a tedious process. The worst difficulty is referred to by Mr. Crampton, namely that the precipitations are apt to be incomplete, thus in attempting to precipitate silver from a platinum-bearing solution, you obtain a silver chloride precipitate containing some of the platinum, and a platinum-bearing filtrate containing some silver. The relative proportions of the metals present also affect the analysis. This is the peril which besets any short-cut method; it may work perfectly on an ore of the character for which it was devised, but on a different ore it may give erroneous results. It seems likely that assayers will have to continue to do what Mr. Crampton, and nearly every other worker in the analysis of platinum-bearing materials, has done; namely, devise for himself a scheme of analysis that most nearly meets his needs.

THOMAS T. READ.

San Francisco, August 16.

The Search for Platinum

The Editor:

Sir—From your recent editorial on this subject it is clear that this metal will be sought with growing zeal during the next few years. The price, which has risen so remarkably since 1890, will be increased still more by the export-tax of 30% to be imposed by Russia in July. (The possibility of this tax you foresaw, stating that it would be borne entirely by the foreign consumer.) During the next decade Russia will levy from every available source of revenue. That may result in a much heavier burden upon the consumers of platinum. Platinum being one of the necessary metals and its utility depending largely on its unique properties, it may be possible to go a long way in taxing the traffic all it will bear. In fact, during recent years consumption has become continually greater in the face of a soaring price. In addition to the above considerations it will be remembered that Russia produces 95% of the world's supply. North America being the greatest consumer, it is interesting to speculate regarding the existence of important deposits on this continent, and with that end in view to consider the nature of the deposits of platinum already known in various parts of the world.

Platinum occurs in various igneous rocks and ores as a primary constituent, in veins and contact deposits, and in placers and beach sands. Other occurrences are known, but they are likely to remain of scientific interest only. Some cited by F. W. Clarke[1] are: in certain Pennsylvanian shales; in ironstone, ferruginous claystone, and decomposed gneiss from Australia; in the ash of some Australian coals; in limonite nodules from Mexico; and as sperrylite in pegmatite at Copper Mountain, British Columbia.

Russia's production is wholly from placers. This is true for the rest of the world also, except for that recovered from nickel ores at Sudbury, the trifling amounts obtained in refining gold and copper in the United States, the future output from the Boss mine, in Nevada. It is natural, therefore, to consider placers as the most promising field of search for platinum. In some gold placers this metal is present in sufficient quantity to form an important by-product, but the total yield from this source in North America is negligible in comparison with the consumption. And while the future will surely see greater attention given to the recovery of the platinum metals from gold placers, as well as to the saving of the finer particles now recognized as an unavoidable loss where only riffles are used, it is safe to assume that this total cannot be materially increased in comparison with other sources of supply. However, the Russian platinum is found in placers that, for the most part, carry little or no gold. Referring to the deposits of the Nishni Tagilsk district, neither Beck nor Stelzner-Bergeat mention in their treatises on ore deposits the presence of gold, though the first author gives an analysis of crude platinum which shows 0.04% gold. Hence it seems possible that similar platinum placers may exist on this continent, and that they have been neglected on account of their lack of gold.

Lode-gold occurs in association with granite and its metamorphic derivatives, whereas the mother-rocks of platinum are of the basic magnesian kind. The gold-seeker may therefore find no gold to attract his attention when he comes across a rich deposit of platinum in placer form. Sometimes, however, gold does accompany the platinum, as in several of the Ural placers and in the important ones of Colombia, where it exceeds the platinum. There is the same association in the placers on the Tulameen river, in British Columbia, which has yielded the two metals in the proportion of one of platinum to three of gold. The latter locality has not proved important, but it is, I believe, the only example on this continent of the conditions to be borne in mind by the prospector seeking platinum. He must confine his search to districts where the proper physical conditions for the formation of placers exist, or have existed in the past, and, judging from all known cases, to districts where there are bodies of olivine rock (peridotite and some

*MINING AND SCIENTIFIC PRESS, March 27, 1915, p. 481.

[1]'Data of Geochemistry,' by F. W. Clarke, U. S. Geol. Surv., *Bull.*, 491, pp. 670-2.

serpentines) or pyroxenite. In the Nishni Tagilsk district the various platinum-bearing streams head in an area of olivine rock (approximately 120 square miles in extent) surrounded by a rim of pyroxenite. Both these rocks contain the metal, but chiefly the former. The placers produced during the erosion of this limited mass of olivine rock have yielded approximately 3½ million ounces and are still being worked; but all attempts to extract the metal directly from the rock itself have been unsuccessful. The land surface here has been exposed to the atmosphere since the close of the Paleozoic epoch at least, and the richness of the placers may be due to the tremendous amount of rock disintegrated in that time.

The following remark by Stelzner referring to these placers is of significance to the prospector. "The precious metal (platinum), according to R. Spring, came originally from the olivine rock, and it is never accompanied by quartz or gold in its placers lying in, or adjacent to, the area of olivine rock." Grains of chromite and magnetite, and to a less extent spinel, are its usual associates. The grains of platinum are commonly coated with a film of iron oxide, probably due to the oxidation of iron, which is apparently always a constituent of native platinum. Finally it may be noted that the olivine rock, usually more or less altered to serpentine, weathers readily. It may, therefore, be only sparingly represented in the gravel of streams cutting its mass, while other rocks, more resistant but perhaps not so important in quantity, form the bulk of the gravel.

The discovery of the high content of platinum in the ore of the Boss mine[2] and the noteworthy fact that it remained for 30 years undetected directs attention to the occurrence of platinum in lodes. Previous to this discovery platinum had been known since 1909 in the same county of Nevada in association with copper and nickel in the ores of the Copperhill district south of Bunkerville. It may be expected that further deposits of this nature will be discovered in this part of the West. Here it may well be noted that whereas assayers sometimes, if not usually, overlook appreciable quantities of the platinum metals in spite of their easy detection on the cupel, they very often find them when searching where they do not exist. I recollect several instances, of which the following is the most instructive. In the autumn of 1911 a widely-known metallurgist announced the presence of platinum in profitable quantity in certain basic dikes near an important town in British Columbia. Later his discovery of a new metal of the platinum group ('canadium') from the same source was reported, and descriptions (?) of it appeared in scientific journals the world over. There was much excitement locally and claims were staked for miles along the dikes. The Minister of Mines in his report for that year said that a large plant to treat these ores was being erected. Yet, when numerous samples were taken from the various dikes alleged to contain platinum in profitable amount, and sent to the three foremost authorities for careful testing, the result in each case was that no trace of platinum was found. The analysts were A. R. Ledoux & Co., F. P. Dewey, chief assayer of the U. S. Mint, and Johnson, Matthey & Co., London. Nevertheless various other assayers continued to have better luck than these, and the excitement was slow to subside. Indeed, even yet some intelligent people in that locality cling to the belief that the platinum is really there, explaining earnestly that the authorities mentioned failed to find it from not using the proper method of analysis! The moral is that the best services should be sought in the detection of small quantities of this valuable metal and that reports of other than reputable experts should be entirely disregarded, alike whether negative or confirmative.

Besides those mentioned there are other occurrences of platinum. While none has yet proved of important commercial value, some give promise of providing a profitable source. Those known are enumerated below.

(1) A gold-platinum contact deposit near the village of Sipongi, Sumatra[3]. An intrusion of granodiorite has metamorphosed a limestone bed of the Paleozoic schists of the district. The lime-silica rock thus produced was found to be composed as follows: 85 to 88% wollastonite, with some disseminated bornite, 12 to 14% garnet (grossularite), and 5% bornite with a crust of chalcocite. In small amounts there were also magnetite, pyrite, braunite, rhodonite, and calcite, with drusy crystals of pyroxene and calcite. A sample of decomposed wollastonite contained 0.15 oz. platinum per ton, 0.1 oz. gold, and 0.05 oz. silver, while samples rich in copper gave only a trace of platinum, 0.35 to 55.2 oz. gold, and 0.35 to 13.44 oz. silver. A short distance from the outcrop, a concentrate obtained from the river sand exhibited small particles of light-colored gold and grains of light-colored platinum 0.1 to 0.3 in. diameter.

(2) A gold-palladium contact deposit near Candoga, Minas Geraes, Brazil[4]. The country-rock, itabirite, is a crumbly sediment of Paleozoic or earlier age and consists chiefly of quartz and specular hematite, the latter usually predominating. Intercalated are thick lenses of lime-silica rock called jacutinga, the result of the action of an intrusion of granite upon the original calcareous strata. The jacutinga consists of the following minerals in proportions that vary greatly: diopside, actinolite, chondrodite, calcite, dolomite, magnetite, and ilmenite, together with grains of gold and bright copper-red jagged plates of palladium-gold. Some native platinum is also seen.

(3) A platiniferous quartzite from New Zealand[1] has been described.

(4) As long ago as 1849 platinum was detected in chalcocite in a gangue of dolomite, quartz, and barite at Chapeau mountains in the French Alps.

[2]'Platinum in Southern Nevada,' by Adolph Knopf, MINING AND SCIENTIFIC PRESS, June 5, 1915, pp. 876-9.

[3]'The Occurrence of Platinum in Wollastonite, etc.,' by L. Hundeshagen, *Trans.* Inst. Min. Met., July 21, 1904.

[4]'Uber das Vorkommen von Palladium und Platin in Brasilien,' by E. Hussak, *Sitz.-Ber.* Kais. Akad. d. Wiss., CXIII, Abt. 1, 1904. Summarized in 'Lehre von den Erzlagerstätten,' by R. Beck (3rd. Ed., 1909), Vol. I, p. 166.

(5) Traces of platinum were discovered by R. W. Brock in sulphide-bearing quartz at the Mother Lode claim, Yale district, British Columbia.

(6) In northern Finland pyritic gold-quartz veins have long been known.[5] Besides 0.05 to 0.1 oz. gold and 0.05 to 0.07 oz. silver per ton there is 0.01 to 0.05 oz. platinum. The vein filling is usually more or less brecciated, and seldom banded. It is composed chiefly of quartz and siderite, with some calcite and dolomite; and a little magnesite, hematite, magnetite, pyrite, arsenopyrite, and chalcopyrite.

(7) The following remarkable deposit is described at Katanga, Belgian Congo[6]. A series of sandstones and quartzites dipping 20° occurs here. One stratum has been prospected for its gold-platinum content. It is described as a quartzitic sandstone, 8.2 ft. thick, with a loose structure and a light-red color. In the decomposed part of the rock at the surface nuggets of gold weighing usually 0.03 to 0.15 oz., but occasionally up to 3 and 5 oz., were found. Shafts sunk 60 ft. disclosed the unaltered rock, in which the gold could be observed only as minute grains and plates, nuggets being exceptional, although one was found weighing 4.15 oz. It was partly native platinum. The following analysis gives the composition of the brown concentrate obtained in washing the sand. The variety and association of metals is unusual.

	%		%
Pb	29.55	P_2O_5	Trace
Cu	9.00	SiO_2	31.45
Fe	6.53	H_2O, O and loss	11.273
Ni	0.24	Pd	0.121
Co	1.02	Pt	0.002
Al	0.16	Au	0.032
CaO	Trace	Ag	0.062
V_2O_5	10.56		

The average for numerous samples was 0.26 oz. gold, 0.28 oz. platinum, and 0.05 oz. palladium per ton. Occasionally palladium was found in larger amount. Only traces of iridium were detected. The high percentage of vanadic oxide was believed due to the presence of descloizite (vanadate of lead) or psittacinite (a lead-copper vanadate), the latter having been discovered in the rock. Knopf mentions vanadium having been found on the Bill Nye claim two miles from the Boss mine, suggesting that cupro-descloizite is the mineral bearing it, but does not refer to it as occurring in the Boss mine ores.

(8) As recently described in the Mining and Scientific Press, chromium, platinum, iridium, and gold[7], together with other metals, have been detected in slate and greywacke of Silurian age in western Germany in the country lying to the east of Cologne and Düsseldorf. Krusch believes the platinum here to have come from the original basic rocks, the detritus of which supplied at least part of the sediments. The various determinations that have been made of platinum in these rocks are discordant, his own results ranging from a trace to 0.8 oz. per ton. He compares these old platinum-bearing sediments with the Ural placers and in explanation of the great vertical range of the platinum in the series believes that the higher members were formed from the detritus of parts of the earliest strata which were subjected to continued upheaval and erosion. Note should be made here of two possibly similar occurrences in the United States. They are given in Bulletin 585, 'Useful Minerals of the United States,' as follows. "North Carolina. A belt of platinum-bearing rock is reported extending from Cedar Falls, N. C., to Danville, Va." (No reference). "Pennsylvania. Cherokee and Laurens counties, platinum occurs in Cambrian grit." (No reference).

(9) A deposit of chromite in the basic edge of a granite in South Africa has been described as containing 1 dwt. platinum per ton of ore (28 to 45% Cr_2O_3)[8].

(10) It is well known that platinum was obtained both native and as the arsenide, sperrylite, in the copper ore of the New Rambler mine in south-east Wyoming. This ore is composed chiefly of chalcopyrite with pyrite, and secondary covellite and copper ores. There is a low content of nickel.

None of the cases enumerated have been productive, with the single exception of the last mentioned. They will serve, however, as already remarked, to indicate in some measure what are the favorable conditions for the concentration of platinum in other deposits than placers and igneous ores. It is noteworthy that in its igneous associations, as in the Urals and at Sudbury, and in the placers resulting in the former case, only traces of palladium accompany the platinum, whereas in the contact deposits and at the New Rambler and Boss mines, palladium predominates. Iridium appears to behave in the reverse manner, being relatively abundant in the crude platinum from the Urals and in the copper ores from Sudbury, while it is not mentioned, or is present only in traces, in the other kinds of deposits. It was noted in the German greywacke, example No. 8, while palladium was presumably not detected at all, which supports the theory of origin given. On the same grounds, the platinum in example No. 7 must have had a different origin from that in example No. 8, being akin in this respect to the lode and contact deposits.

Chemically, platinum is relatively inert like gold, and one naturally associates these two precious metals. But their chemical properties are by no means parallel. A discussion of gold and the platinum metals from this and a geological point of view would render possible deductions regarding the conditions that most favor their concentration to form deposits, and would also indicate their relative differences. In the discovery of new forms of ore deposits, however, the prospector and the miner are usually the real pioneers; and of those who follow none are more astonished at the new, or it may be 'impossible,' phenomena than the geologist and chemist.

G. S. Scott.

Slocan, B. C., June 27.

[5] 'Lehre von den Erzlagerstätten,' Vol. I, p. 448.

[6] 'Lehre von den Erzlagerstätten,' Vol. II, pp. 203-4.

[7] "The Platinum Deposits of Germany's Paleozoic,' by P. Krusch, translated from the German by F. Sommer Schmidt, Mining and Scientific Press, Dec. 5, 1914, pp. 879-81.

[8] 'Lehre von den Erzlagerstätten,' Vol. I, pp. 64.

Charles Butters and the New Metallurgy

AN INTERVIEW. By T. A. RICKARD

The actions of some people are significant. They have the faculty of anticipating next year's almanac. Charles Butters is an engineer whom I have always credited with a kind of technical prescience, a keen sensibility for the metallurgical requirements of tomorrow. His career is full of episodes that confirm this friendly guess of mine. Just now we appear to be about to make a critical turn in metallurgical advance. He is my neighbor. Why not ask him to express his views in writing, more particularly as he is conducting experiments on the very process that threatens to revolutionize the treatment of ores, as MacArthur's cyanide process did 25 years ago. But, like other men of alert mind and fluent speech, he dislikes to write. He cannot be persuaded to prepare an article.

THE APPROACH TO THE BUTTERS LABORATORY.

Well, if not in that way, then in another way it is possible to elicit valuable information. I asked him to submit to an interview—a friendly interview—by one who appreciated his useful work and desired greatly to give the benefit of it to the profession of which he is a distinguished leader. He yielded to my importunity.

You were born in California?

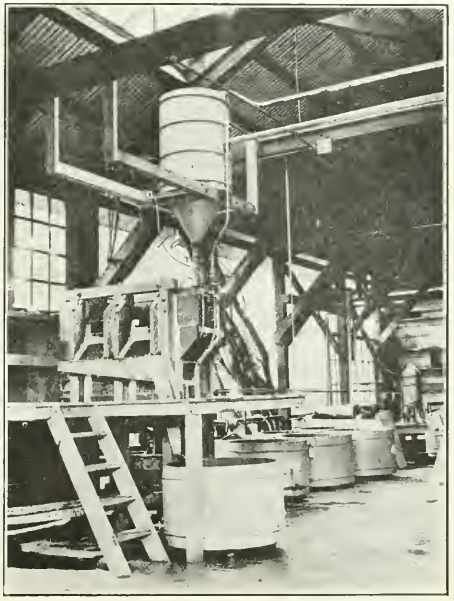
No; I was born at Haverhill, Massachusetts, in 1854 and came out to California when 10 years old. My father brought me. He was a leather manufacturer, but immediately after arrival here he started mining in Placer county. He was over 50 then and really was too old to go into a new business.

You seem to have inherited his initiative. You graduated at the University of California, didn't you?

Yes, in 1879. After graduation I went to New Almaden, in Santa Clara county, as chemist to the New Almaden Quicksilver Mining Co. But I was not long there. Getting a better offer from my brother Henry, I left California and went to Fairplay, in Colorado, where I established an engineering (that is, surveying and assaying) office with William H. Leffingwell, a class-mate of mine at the university. But our partnership was short-lived, because I saw an abandoned gold mill of which I thought I could make a success.

What happened?

I fitted up the mill and treated 30 tons—and went broke. That's the way to learn. Then I obtained a position as assayer and metallurgist in a silver mill in Frying Pan gulch, just outside of Leadville.



FLOTATION PLANT IN THE BUTTERS LABORATORY.

The accompanying photograph shows the Minerals Separation unit. The tanks are on little trucks, for convenience in moving. Crushing is done by a Krupp dry ball-mill and a small Hardinge conical tube-mill. Four laboratory tube-mills have been made out of 16-in. pipe, using steel balls to do the grinding. A Dorr classifier, and centrifugal pumps for elevating, are included in the testing plant. Also a complete vacuum-filter equipment. A bigger Minerals Separation plant and an equivalent Callow apparatus are about to be added.

When was that?

In 1881. Having treated 30 tons of ore in my own mill and gone broke in the attempt, I thought I knew enough to run the other fellow's mill. But in the interval I had visited every silver mill there was in Colorado and studied their methods carefully.

So you succeeded this time?

Yes. I remember that David Brunton visited me at that time and complimented me on my work. The firm of Taylor & Brunton was of great help to me; both partners were thoroughly informed concerning the metallurgy of silver, and they were very kind to me.

How long were you at Leadville?

About a year and a half. Then I went to the Holy Cross district and started a 20-stamp gold mill with plain amalgamation. From there I went to New York as agent for a San Francisco firm, the Pacific Iron Works. That was in the latter part of 1882. I didn't like the work at all; I was a metallurgist, not a salesman. However, I made the acquaintance of a lot of useful people. I made it my business to know all the mining engineers and people connected with the mining business. I can say that I always made it a point in my youth to make the acquaintance of the ablest men in my profession and I preferred to work for them at a comparatively small salary, rather than work for the non-technical public. I was criticized by some of my friends, who said that I could never make any money in that way, but the result of this policy was that I found myself working for Stetefeldt, Clarence King, Stephen Krom (who invented the rolls), Fraser & Chalmers, R. P. Rothwell, and Walter McDermott. McDermott was specially kind to me and put me onto the San Sebastian mine, of which I will tell you shortly. William Frecheville was another good friend; he was then in North Carolina, and employed me in expert work, that is, ore treatment.

So you left New York soon?

Yes, and went back to Colorado, where I started a silver mill, a custom plant, at Crested Butte, for a New York company.

What mill was it?

It belonged to Commodore Webb of New York and treated ore from the Ruby Silver and other mines. I worked all the ores in the district by dry crushing in a stamp-battery, roasting in Bruckner furnaces, and amalgamating in pans.

The crushing dry under stamps was tough?

Awful. No crushing capacity and no end of dust.

How long did that last?

About a year. Then I returned to New York and opened an office on my own account. That was in 1883. I shared a laboratory with Krom. We did general metallurgical work. I found a process for treating the San Sebastian ore.

What was the difficulty?

You could not amalgamate it. If you tried to concentrate, you lost about 80% of the gold with the slime. This was due to the combination of the gold with tellurium, which also was combined with the copper, as the mineral rickardite—a fact that we discovered in later years. The ore also contained molybdenite.

How did you solve it?

I found it could be readily treated by chlorination. I treated 5 tons in New York and then made a contract to build a mill for the company.

Where did you get your experience in chlorination?

A few months before I had made a honeymoon trip to North Carolina and taken charge of the Designolle reduction works, belonging to P. Bechet et Cie., a French banking firm. At that custom mill they bought various concentrates and roasted them, then the roasted concentrate underwent amalgamation with mercuric chloride in barrels. It was a wretched failure. The company failed and left me strapped. All that I had on hand was 20 tons of residue in the form of roasted concentrate running a little over $15 per ton. In order to get back to New York with my wife and mother, I had to find a method of extracting that $300 worth of gold.

What did you do?

I commenced to experiment in the laboratory by aid of a glass funnel and one pound of the roasted ore. By saturating the ore with chlorine gas, after a couple of days I extracted the gold out of that pound of ore. Thereupon I took 100 lb. and contrived a generator, attempting to treat it in the half of a small oil-barrel. After two weeks of vain effort I found that I could not saturate the stuff with chlorine gas. Finally I ascertained that the roasting previously done in the mill had been most imperfect. Thus, by experimenting on the 100 lb. of residue, I ascertained the absolute necessity of a dead sweet roast. At once I re-roasted the 20 tons and by the aid of 8 oil-barrels I built a little chlorination plant. In the end I had 100 slugs each representing $3 in gold. I sold some of them at the Charlotte mint and thus got enough money to pay for the journey to New York and make a fresh start. After that I was a chlorination expert. When the San Sebastian ore came to me, I was ready to apply chlorination.

So you went then to Salvador?

Yes; and built a 30-ton chlorination plant, which was entirely successful. They paid me $1000 per month. I was then 31. I remained 2½ years.

Then?

I returned to California and went to Kennett, in Shasta county, where I established a chlorination plant. That was in 1887. We extracted gold, silver, and copper. We received ores from distant localities, such as Grass Valley; for instance, from the Coleman brothers, who controlled the Idaho mine.

Was that enterprise successful?

Yes, metallurgically. I treated some most difficult ores, but I could not get enough business, so it was a hard pull. Incidentally, I treated several hundred tons of wet raw tailing running $4 or $5 in gold with a very slight impregnation of chlorine gas and obtained an almost complete extraction. After I had been there about two years and spent all my money and my plant had been seized by the sheriff—but I got out of that—Huntington & Hopkins protected me till I was on my feet again.

It was about time for another migration, was it not?

You have guessed right. At the end of 1889 Professor Christy appeared suddenly one morning as I was laying pipe in a ditch, in the rain. He told me that he had received a cablegram from Henry C. Perkins, asking for a man to go to South Africa. The qualification specified was that the man was one that owned his own reduction works.

You agreed to go?

Instantly; without a second thought. I felt perfectly competent to do the work. My wife and I proceeded to Johannesburg by way of London.

ical establishment. We bought all kinds of by-products. I was managing director for 5 years.

When did you first come in touch with the cyanide process?

At the end of 1890, nearly a year after my arrival at Johannesburg. The Cassel people had just completed a local plant to treat 1600 tons per month of stamp-mill tailing.

You studied that?

Certainly. I watched it most suspiciously. But when the clean-up was made, at the end of the first month, I was absolutely satisfied that the cyanide process was the

THE DEVISADERO MILL, IN SALVADOR.

There you built the chlorination plant at the Robinson?

Yes. I was assistant to Hennen Jennings, who was consulting engineer to H. Eckstein & Co. It was on Jennings's initiative that Perkins had cabled to Christy.

This plant was successful?

The Robinson chlorination mill was successful from the very start. I had the pleasure of making the first bar of gold produced by the chlorination process in South Africa.

You remained there some time?

Yes; I ran that plant until 1894, when I resigned and organized the Rand Central Ore Reduction Company.

On your own account?

Largely; this was a custom chlorination and cyanidation plant, with a refinery—it was a general metallurg-

most wonderful I had ever seen. I realized that it would kill chlorination and revolutionize metallurgical practice on the Rand. Immediately I hastened to urge the Ecksteins to buy the rights to the process in South Africa.

What happened?

They thought I was too quick in my judgment. Shortly afterward the owners of the patents realized the importance of the process and it could not be bought at any price.

Therefore, I suppose, you used cyanidation yourself in the big custom plant you built in the Central Rand?

Yes; immediately after Jennings realized what cyanide meant, he ordered me to design a plant to treat the entire Robinson output. At that time the Robinson had 40 stamps.

You designed that cyanide plant also?

Yes; and to show what metallurgical progress meant to the Robinson I can say that the mill was producing 4000 ounces of gold at the commencement of 1890, while in 1892 the mill was producing 8000 ounces and the chlorination plant 8000 more.

How were chlorination and cyanidation combined?

We concentrated the gold-bearing pyrite on Frue vanners, getting a 5-oz. concentrate, which was treated in the chlorination plant, while the residue was delivered to the cyanide annex.

So cyanidation was only applied to the residue?

At that time. Of course, a few years later the concentration of the pyrite was stopped and everything cyanided, after finer crushing.

How long were you on the Rand?

About 8 years. Then I returned to America, bought the San Sebastian mine, and organized the firm of Charles Butters & Co., Ltd., in London.

You had kept in touch with the San Sebastian?

Through all those years. I believed it to be a great property that had been grossly mismanaged. In association with David J. Pullinger, of Johannesburg, I paid $100,000 for it and within a year had $1,000,000 worth of 3-oz. gold ore in reserve.

What has it done since?

It has produced over $10,000,000, half of which has been distributed in dividends.

Did you remain long in Salvador?

I stayed there less than a year the first time, getting the enterprise fairly started. We erected a cyanide plant first to treat 20, then 40 tons, per day, increasing the capacity finally to 120 tons per day.

What was your next metallurgical departure?

I went to Mexico and established a cyanide plant at Minas Prietas, in Sonora. This was built to treat the dumps and the tailing from an amalgamation mill belonging to the Grand Central mine.

Was there anything special about that plant?

It was the first in Mexico to treat slime by agitation and cyanide. From there my assistants, E. M. Hamilton and C. G. Patterson, went to Guanajuato, to erect a similar plant.

When did you develop your vacuum-filter?

Soon after the Prietas mill was finished—in 1901—I built a slime-plant at Virginia City, to treat the old Comstock dumps. This material was a sticky stuff, much oxidized, colloidal, very tenacious, and hard to settle. I made a complete fizzle of the job at first, losing $100,000 in the first year. Altogether we lost $475,000, which was the price for learning how to filter slime. I developed my system of filtration, and in doing so I was assisted particularly by Mr. Patterson. Since then he has erected a number of similar plants in South Africa. As a sequel to our experience at Virginia City, all the Tonopah plants, particularly the Tonopah mill at Miller's, were designed. This was done in 1907 after we had treated 50,000 tons of their ore at Virginia City.

Eventually your work brought you into conflict with the Moore patents?

Yes, unfortunately. The courts gave an adverse decision in 1911.

Whereupon you turned your attention to a new field of research?

I continued research into the physical condition of slime. To obtain the latest information, I went to Germany, on the suggestion of my friend, Mr. H. L. Sulman, of London, and interviewed the great specialist in colloidal chemistry, Dr. G. Bredig of Karlsruhe. I arranged with him for a series of investigations into the physical characteristics of metallurgical slime. But the War stopped that.

When did you become interested in concentration by flotation with oil?

In 1899, as soon as I heard of Elmore's first work with this process in Wales, I went down there to see it and became sufficiently interested to make a contract with him to introduce flotation into the United States and Mexico. I have here now the first flotation plant made in the United States. It used to be in the basement of the Dooly building at Salt Lake City and consists of a cylindrical mixer with a centrifugal machine to separate the excess oil from the concentrate. That process was really 'oil flotation'—the floating of the sulphide mineral in an excess of oil on the top of the pulp.

Why did you drop it?

I could get no better results than by ordinary water concentration.

On what ores did you try it?

Anaconda ore and slime, also various copper ores from Bingham. We did not understand oiling at that time—this was 15 years ago—nor did we appreciate the necessity for making a froth. The excess of oil we used—20 lb. per ton of ore—made a fearful mess.

It did not attract you then?

It was impracticable in the form then adopted.

What did you do next?

In June 1914 I engaged the firm of Sulman & Picard to do some experimental work for me on the application of flotation to residues from the Nipissing mill, at Cobalt. The results were so startling that, at the first opportunity, I got into touch with the Minerals Separation company with a view to making systematic tests with flotation on the ores of various mines in which I am interested, such as the San Sebastian and Devisadero in Salvador, the Copala in Mexico, and so forth.

You returned to California?

Yes, I came to San Francisco and worked for a month in the laboratory of Mr. E. H. Nutter, the representative here of the Minerals Separation company. I perceived at once that the field of experimentation was very wide, so I arranged with Mr. Nutter for the loan of one of his company experts, Mr. F. A. Beauchamp, and established

a flotation department in my home laboratory here at Berkeley.

You have obtained interesting results?

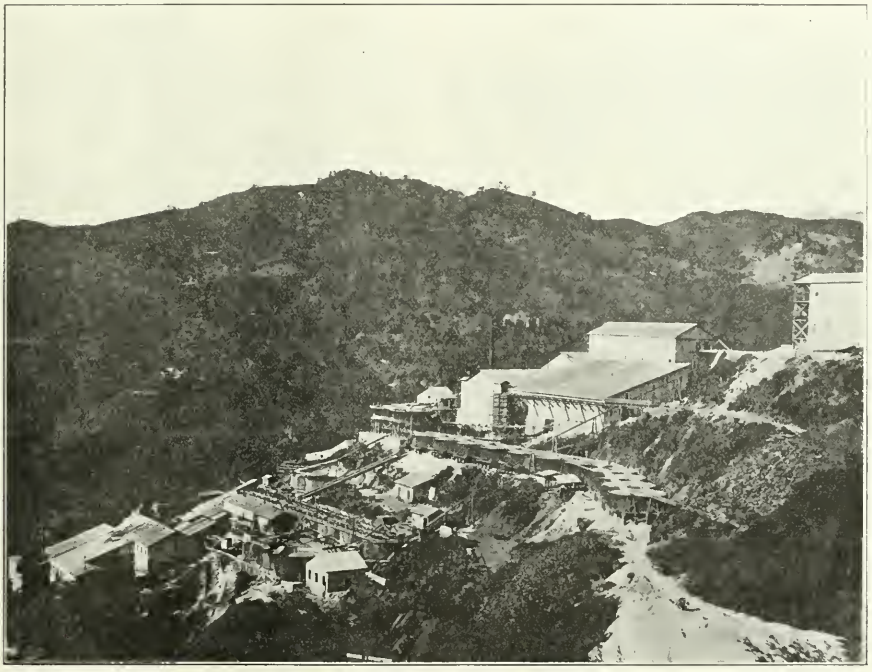
Since we started we have made determinations on ores from widely separated mining regions. At the start these tests were made on 500 grams, and yielded remarkable results. But tests on pound samples did not satisfy me, so we built a machine to treat 10 to 15 lb. From that we proceeded to make an apparatus capable of treating lots of any size. We are about to make considerable additions to our flotation plant.

That is an important fact.

Yes; as you have often said, "The failures are as interesting as the successes." We shall be prepared to give you full particulars for publication. Mr. J. E. Clennell has made a great number of tests and the description of his work will prove useful to the profession, I feel sure.

Can you produce a richer product by flotation than by water concentration?

In all our work, the first thing we aim to obtain is a rich concentrate and a residue that can be discarded.



THE COPALA MILL, IN SINALOA, MEXICO.

How much oil do you use?

In our experiments we have been using from $\frac{1}{2}$ to $1\frac{1}{2}$ lb. per ton of ore.

How much acid?

None. We work in an alkaline solution.

Did you experiment on the subsequent treatment of your product, namely, the concentrate from flotation?

Of course. To our complete surprise we found ourselves unable to cyanide the concentrate produced by flotation. If this product can be shipped to a smelter, it is a simple matter, but in many cases it is imperative that the concentrate be treated on the spot. Evidently, if it be the oil that prevents cyanidation, we might produce the concentrate by the use of soluble oils in the flotation process, but, so far as our results go, the class of oil that produces the cleanest concentrate is just the one that we are unable to dissolve.

When this can be done, the treatment of a gold and silver ore is tremendously simplified.

You have done this in some cases?

We can do it on a silver ore, if it is not too much oxidized. Even on surface ores some of our results are surprisingly good. For instance, take the old dumps that have been mined, milled, and re-concentrated at Virginia City for the last 30 years. We can get a high-grade concentrate and a comparatively low residue even on this material; that is, we can take material assaying $5 per ton and impoverish it down to $1.50 per ton while getting a $170 concentrate. But even this will not compete with cyanidation, because I cannot treat that concentrate. I can ship it to the smelter, but the freight and smelter charges, plus the $1.50 in the residue, represent something like $16.50 as against the 75 cents per ton lost in the cyanide tailing.

How about Mexican silver ores?

On ores such as those of Copala, in Sinaloa, I can obtain a high-grade concentrate, even from the dumps. For instance, on what we call the *colorada manta* the results are:

	Gold, oz. per ton.	Silver, oz per ton.
Original ore	0.10	10.10
Concentrate	0.84	198.48
Tailing	0.01	0.15

One would think that as this ore is almost completely oxidized it would give trouble, but the silver has been left in such a condition that it can be floated, probably as argentite.

You get better results on sulphide ore?

Naturally, when unoxidized the ore presents no difficulty. For example, a sample from the dump at the San Carlos adit at Copala gave these results:

	Gold, oz.	Silver, oz.
Original ore	0.11	15.60
Concentrate	3.58	468.14
Tailing	0.02	1.48

Then flotation promises to have a wide application?

One cannot say that it is a panacea for all kinds of metallurgical troubles, but it is a process that every metallurgist must learn, because if he does not ascertain whether there is a place for it in his flow-sheet he will be missing big chances.

But the difficulty of treating the flotation concentrate?

On a gold concentrate like that from San Sebastian ore we can get a high extraction by cyanide, after roasting, but where both silver and gold are present our results are poor. Take, for example, the roasting tests on flotation concentrate from Virginia City, assaying 2 oz. gold and 182.44 oz. silver, we obtained these results:

Treatment.	Gold, %	Silver, %
1. Oxidizing roast, following by sulphuric acid wash, then cyanidation	90.5	19.7
2. Plain oxidizing roast, without acid wash, then cyanidation	75.5	6.7
3. Oxidizing roast, followed by chloridizing (5% salt) roast, then cyanidation	80.5	75.6
4. Raw cyaniding	35	5.75
5. Following this with a chloridizing roast, and further cyanidation, we obtained additional	13	23.45
Thus by 4 and 5 combined	48	29.2

The metallurgical treatment of flotation concentrate is an entirely new subject.

Is it not a question of eliminating the oil in the concentrate?

I do not know.

Is it not possible to find a solvent for the oil?

I should say that it might be easier to use an oil we could dissolve than it would be to find a solvent for the oils we use, but, as I have already stated, up to the present, the best results are obtained with insoluble oils consisting essentially of tar products.

Is that because the insoluble oil gives you stronger bubbles in the froth?

Yes, the insoluble oils are better collectors of the sulphide mineral; such oil is added just to give the froth sufficient volume to constitute a convenient vehicle for the removal of the oiled mineral.

Do you apply flotation to the tailing or to the crude ore of San Sebastian, for instance?

Our average residue at San Sebastian after cyaniding is $2.16 per ton. We can reduce that by flotation to 20c. per ton and obtain a concentrate assaying $7 to $18 per ton, depending upon the part of the mine from which the ore comes. The ore itself can be subjected to flotation so as to yield a tailing assaying from 75c. to $1 per ton, on an original ore assaying $20 per ton.

So that, if you knew how to extract the precious metals in your flotation concentrate, you would proceed to use flotation before cyanidation?

With cyanide we get a residue of about $2 per ton. In our flotation tests we obtain an extraction of 95% at once, leaving a tailing containing $1 per ton. We find that by roasting at a temperature not to exceed 500°–600°C. the copper is left as a sulphate. By washing thoroughly with water, we extract 10 lb. copper per ton and then reduce the flotation concentrate by cyanidation from $100 to $1 per ton.

Does the question of cost arise?

We figure that we would gain about $2 profit per ton by using flotation as described.

How about the chemicals required?

We would use about ½ lb. oil per ton, as against 5 lb. cyanide. We would have to use cyanide for the treatment of the concentrate, but it would be only 2 lb. per ton and the concentration would be in the ratio of 4 to 1, that is, ½ lb. cyanide per ton of crude ore.

You have experimented on the ores of other mines besides your own?

Certainly, enough to indicate that every silver mill, at least, should ascertain whether flotation is applicable. For example, we tried the ore of another mine in Sinaloa. The results were:

	Gold, oz. per ton.	Silver, oz per ton.
Original ore	0.52	15.94
Concentrate	8.16	242.36
Tailing	0.035	2.07

These figures indicate that it would be possible to beneficiate an enormous quantity of low-grade ore not available hitherto for treatment, without additional capital expenditure for power.

I presume you have not decided what is the best type of mixing machine?

We realize the necessity for a most intimate mixing of oil and ore, after which quiescence is necessary in order that the bubbles may not be broken, thus facilitating a cleaner separation. It seems to me that the two stages of treatment should not take place in the same machine.

Do you prefer the pneumatic or the mechanical agitation?

All the work done in this laboratory up to date has been performed with the Minerals Separation machine. At present, with my limited knowledge of the process, I would say that mechanical agitation is best for the oiling stage, because it is more positive in its action. Mr. George O. Bradley was kind enough to show me a new positive oiling machine that he has devised; it impressed me as likely to prove effective. I believe that Mr. J. M. Callow's idea of separation in tank-like cells is sound. We are now installing a complete set of Callow apparatus. He has shown that mechanical mixing is not necessary in certain cases of copper ore, but the problems arising from the treatment of copper ores are quite different from those to which I have devoted myself. The proportion of mineral to be extracted from a gold and silver ore is extremely small as compared with that obtained from a copper ore. The froth required for the separation of precious-metal sulphides is more delicate and requires different handling.

As to the various oils?

During a recent visit to Salt Lake, Mr. R. C. Gemmell was kind enough to permit me to visit the Arthur plant, where I met Mr. F. G. Janney, Jr. Frankly, I was dumbfounded to see what a lot of work he had done on the subject. Mr. Janney has established a laboratory for the analysis of flotation oils and has records of over 500 oils already. This is work of supreme importance, for he is ascertaining what are the elements in the various oils that accomplish given results.

Some ores require an acid and others an alkaline treatment, do they not?

Undoubtedly some ores work better in an acid medium, but as I realized how much greater is the ease with which an alkaline solution can be handled in a mill, I have not rested content with any acid treatment. In every case we have worked out our results in an alkaline solution. In fact, if cyanidation is to follow flotation, I consider it essential to perform the flotation in an alkaline solution; but, you understand, I refer to gold and silver ores only, not copper ores.

Finally, Mr. Butters, you are much impressed with the importance of flotation?

Yes, indeed. I am convinced of the far-reaching importance of the process. It has started a new era in the concentration of ores.

QUARTZ-REEFING predominates in Victoria, so a report says. Translated into American this means that there are more quartz mines than placer mines in the State of Victoria, Australia. A considerable amount of gold is obtained from alluvial workings, both surface and deep leads. The deepest mines in Australia are found in the Bendigo district, where the two deepest shafts on December 31, 1914, were 4614 and 4318 ft. deep. In all, there were 53 shafts in this district more than 2000 ft. deep.

Electricity in Metallurgy

In summarizing their investigation of this subject, Dorsey A. Lyon and Robert M. Keeney, in Bulletin 104 of the A. I. M. E., make the following general conclusions:

1. The market for hydro-electric power for electro-metallurgical industries in general is not great; and under the best conditions the part consumed in electro-metallurgical plants would be a very small proportion of the total hydro-electric power that it is possible to develop in the Western States.

2. Although the outlook at the present time is not favorable to the establishment of extensive electro-metallurgical industries, we are nevertheless of the opinion that such industries will, in time, be established, but perhaps along other lines than at present, that is, other than the production of aluminum, ferro-alloys, pig-iron, steel, etc. It is also doubtless true that the electric furnace will in time be quite generally used for the local production of steel castings, but an extensive use of the electric furnace for this purpose will not involve any great consumption of electric power.

Therefore, if our analysis of the situation be correct, is it reasonable to expect that the hydro-electric power companies may ultimately be able to dispose of a great portion of their surplus power by reason of the development of new electro-metallurgical industries? We believe they will, and for this reason:

At the present time the metallurgy of the non-ferrous metals is rapidly changing. The processes which were suited to the treatment of non-ferrous ores five or ten years ago are at the present time not satisfactory, because the non-ferrous metallurgical plants of the country are called upon to treat ores of a lower grade, and also more complex than formerly. Such being the case, processes must be devised which will meet these requirements. However, we do not for a moment imagine that electro-thermic or electrolytic processes will prove to be the only solution of the many problems which are at the present time confronting the non-ferrous metallurgist. Although such processes may greatly assist in solving these problems, we are of the opinion that further research work will indicate other solutions. This is true, especially as regards hydro-metallurgical processes, because the profitable treatment of the low-grade and complex ores above mentioned requires the use of cheap reagents. Such being the case, the hydro-metallurgical treatment of such ores may bring about the establishment of an electro-chemical industry for the production of the necessary reagents and thus indirectly the metallurgical industry may bring about an extended use of hydro-electric power. Whether this will prove to be the case or not, remains to be seen. It can only be determined by a careful investigation of the subject, and by extensive research, having for its object the finding of new uses for electricity in metallurgical work.

A possible use for vast quantities of power may be found in the fixation of atmospheric nitrogen.

Mining in Utah

By L. O. HOWARD

Mining in Utah is fast returning to normal conditions. It might with more truth be said that it has passed the normal. With the Utah Copper Co. in a position to mine to the full capacity of its concentrating plants, copper production is again making records. With the favorable copper market, this company, one of the few to maintain its regular dividend during the depression following the beginning of the War, is making a large profit, which it has justly decided to share with its employees by means of increased wages. Details of the new scale have already appeared in the PRESS. Other companies are now following suit, so that miners and salaried men employed by the large producers are enjoying greater prosperity than for some time past.

Other business conditions being good locally, attention has been attracted to the mining industry, with the result that many small investors are putting a little money into mining prospects. As copper, lead, and zinc now command high prices, confidence in mining has been stimulated, with an effect that is far-reaching. In the districts, new or formerly dormant, such as Bull Valley, Big and Little Cottonwood, Saline, and many others, prospects are being developed with encouraging results. In the older districts leases are in demand and a general air of activity is manifest.

Lead-producers throughout the State have responded to the increased price of that metal. Production is now fully in keeping with past records in Park City, Tintic, Beaver, and Stockton.

At Park City, the four old operators, Silver King Coalition, Silver King Con., Daly West, and Daly-Judge, are producing progressively increasing tonnages. Tailing-dumps are being acquired for their zinc-content, the month just past marking the commencement of operations in the up-to-date mill on the large dumps at Atkinson, and the furtherance of plans in connection with the old Grasselli tailing at Park City, where the second mill of the Grasselli Chemical Co. has passed into other hands.

It is, however, necessary to record the cessation of operations at the chlorination plant of the Park City Mills Co. In my last article I mentioned the difficulty in gold extraction. On the American Flag ore, which has a high combined lime and magnesia content, it has been impossible to extract the gold commercially. Since gold is the principal metal in these ores, the failure is serious. Consumption of acid was excessive, and although the extraction of the base metals was satisfactory, a big excess of chlorine failed to dissolve the gold. Large amounts of bleaching powder and acid added to the charge in the vats evolved fume in such quantity that the men were driven from the work, yet upon circulating this solution the chlorine was consumed without appreciable benefit in the saving of the gold. There is too much copper in the ore for satisfactory work with cyanide, except at the expense of high consumption. Concentration has not appeared feasible to the owners, for the ore will not stand much expense. Experimentally an excellent extraction of copper and gold is possible by preliminary treatment with ammoniacal solutions, followed by cyanidation, but the consumption of these reagents has not been determined. It might also be remarked that preliminary experiments on presumably representative ore resulted in a recovery of fully 85% of the gold by chloridizing roasting, yet the process failed in commercial application.

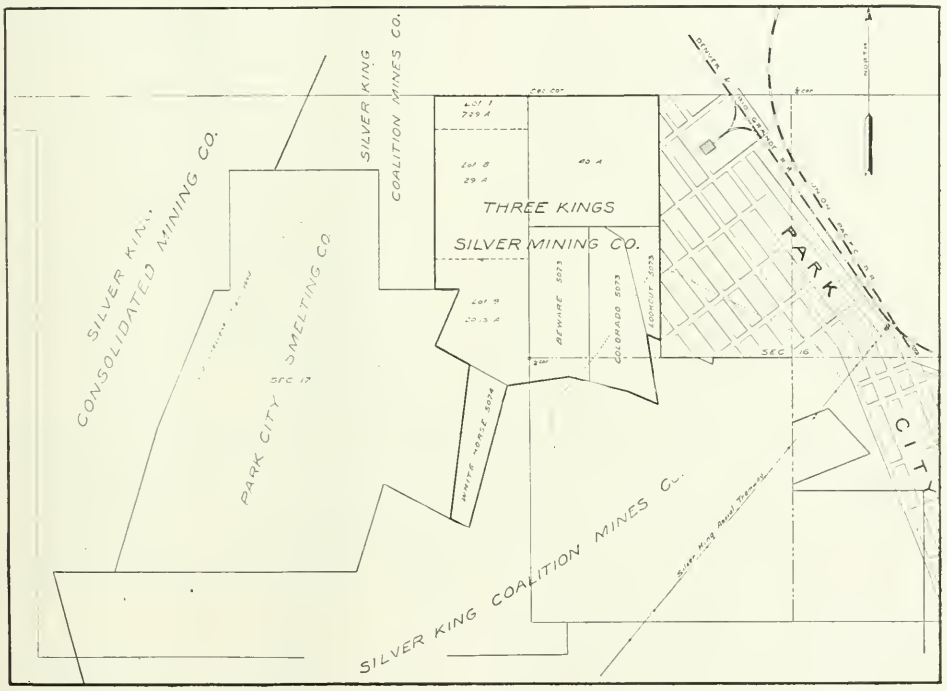
It is likely that further experiments will be undertaken. Pending a satisfactory settlement of the difficulties the mill is closed-down indefinitely. Of the three chlorination plants of much promise some months ago, none are now in operation.

A serious attempt to enlarge the boundaries of the Park City district is being made by the Three Kings Silver Mining Co., which is seeking ore farther north than any yet found in the district. For many years sporadic attempts have been made to do something with this ground—attempts that were thwarted by diverse ownership and lack of the necessary resources. When the control passed under one management, a two-compartment working shaft was started. This has now reached a depth of 530 ft. The bonanza horizon in the adjoining Silver King Coalition and Silver King Consolidated mines lies in the Park City lime formation, just above the Weber quartzite. While the other companies have had to sink 500 to 700 ft. to reach the Park City formation, which is itself about 800 ft. thick, the Three Kings has the advantage of starting in the Park City formation, and should therefore reach the Weber quartzite in another 200 to 275 ft. The company is well financed, work is being done in an efficient and conservative manner, and the results of this exploration should be of the greatest interest. Excluding management expenses, the officers giving their time gratis, the shaft has cost to date $35 per foot. Mining conditions are favorable, the haul to the railroad being but three-quarters of a mile, and the shaft but 180 ft. above the tracks.

The long and honorable record of the older lead districts has made their names famous outside the State. Among the less known districts is that of Stockton, nine miles from the station of the same name on the Salt Lake route, 41 miles west of Salt Lake City. Silver-lead and

zinc carbonates occur in the bedding-planes of a porous limestone, and at the intersections with numerous fissures. In view of the small amount of publicity this district has received, and the lack of information available except to those working there, some details of individual operations may be of interest. The district is one of the oldest in the State and has a substantial record. The recent favorable factors introduced into mining have led to much exploration and development. The Hidden Treasure mine is the largest producer. Twenty-five to 30 men are engaged, on company time and on leases; stopes, so that the development cost is nil. The thickness of the deposit varies from three to four feet.

Shipments are also being made from the Thad Stevens property, Utah Queen ground, and the Kirk lease on the Big Lead mine, the ore of which is characterized by an appreciable amount of gold. The Dry Canyon Con. is being developed by one or two men who have made occassional shipments from stringers cut in extending the main adit, which is now in over 4000 ft. The Wandering Jew is developed to the shipping stage and the Eureka-Ophir is being prepared for development.



MAP OF PART OF THE PARK CITY DISTRICT, UTAH.

shipments run as high as 1000 tons per month. Stoping is done with air-drills, and both lead and zinc carbonates are shipped.

On the Mono Development ground four sets of lessees, of four to seven men each, are working, all in silver-lead carbonate, shipping 250 tons per month. The ore is found on the bedding-planes of the lime and in intersecting fissures. A car recently sent to the Salt Lake market assayed 51 oz. silver and 12% lead; another assayed 30 oz. silver and 24% lead. These figures indicate the range in the amount of the principal metals. With the addition of power-drilling equipment the output will be greatly increased.

At the Queen of the Hills mine 25 men are working. Shipments of ore assaying 41% zinc are being made. The output is estimated at 200 tons per month. This ore is cheaply mined. It lies on the foot-wall of old lead

While the older mines at Tintic, for example, have not obtained as much benefit as was anticipated from the high price for zinc, due in part to the low grade of their ores, new properties are being developed elsewhere to supply a good grade of carbonate ore. At Saline, three miles west of Promontory on the Southern Pacific cut-off west of Ogden, there is much activity in the search for zinc ore. The Lakeview mines have been well developed and a large tonnage is said to be exposed. The ore horizon here is also along the bedding-planes of a limestone, which dips at about 30° across a series of parallel ridges, on both sides of which ore can be traced. The principal showing is on the ridge covered by the Lakeview locations. Numerous openings at different elevations on both sides have shown that the ore continues for 3000 ft. along the strike. Assays indicate a zinc content averaging 35%. It is planned to ship at the rate

of 700 tons monthly. Thirty-five men are employed. In certain portions of the ore-horizon, there is said to be seven feet of high-grade lead ore on the foot-wall. Leases are being taken up rapidly and companies formed to explore the supposed continuation of the known ore-beds, and high hopes are entertained for the development of another base-metal district.

Operations at the radium mines in the southeastern part of the State have been paralyzed by the War. Some desultory development has been undertaken but there are scores of claims on which assessment work is not being done, the situation appearing hopeless to many operators, so that only the very best ground is protected. Had the interference of the Government in the radium business not deterred capital from building other extraction plants it is possible that other markets would have been created for these ores, and the smaller operators—outside the two large interests that have their own reduction plants—would not have been entirely dependent on the foreign markets that have now been cut off by the War. The action of the Government, while in no way providing for the sale of the ores of producers not affiliated with the Bureau of Mines, has prevented others from buying them.

As compensation for the paralysis of this promising industry the War has undoubtedly accelerated the development of the potash deposits at Marysvale. At the property of the Mineral Products Co. 150 men are rushing work on the aerial tramway and mill. This plant is to have a capacity of 100 tons per day, and is being erected in the foot-hills of the Sevier range six miles south-west of Marysvale and four miles from the mine. A tramway to extend one and a half miles from the mine to a place where ore can be loaded by teams, is being erected rapidly. The alunite deposit is at a high altitude, 9000 to 11,000 ft., and in one mile the tramway has a difference in elevation of 2000 ft. The principal difficulty in construction is in getting materials on the ground, but every device that ingenuity can suggest is being used to insure the completion of the tramway before September 15, and it is confidently expected that the first commercial production of potash in Utah will begin then.

While the revised figures of the U. S. Geological Survey show a decline in 1914 in the production of all metals in Utah except lead, the dividend payments for the first seven months of 1915, including disbursements of all mining companies making public reports, aggregate $4,050,000, compared with $3,410,000 for the same period in 1914, indicating a much better position in the present year.

When negotiations have been in progress for the purchase or annexation of new territory by the United States, one of the strong arguments for its acquisition has been the presence of valuable mines. This was the case as regards the Louisiana Purchase and the annexation of California. The possession of mines is desired by all nations and mining territory is often fought over—witness Galicia.

How Not to Build a Smelter

Some of the peculiarities of the Salida smelter as originally built should serve to prevent the younger men from making similar mistakes; the older men can get their satisfaction by reflecting that they never did anything quite so far removed from good practice.

Originally, a brick wall, with a narrow door in front of each blast-furnace, was constructed. How the work was to be done behind this wall is not known, but it shows that the designer did not know how to do the work.

The water jackets were held in place by a 12-in. I-beam running the length of the furnace, thus effectually preventing any one from examining a tuyère or jacket.

The shaft-walls on the feed floor were so thick that the feeders were shoving ore into one end of a tunnel, and, since the opening was not as wide as the shaft, the ends of the furnace could not be fed except by throwing the charge around a corner—which, of course, was not done.

The proposal to concentrate matte, carrying 20% lead and 5% copper, in a copper-matting furnace was intended to do away with the necessity of roasting equipment.

The largest Corliss engine on the plant was the exhibition engine at one of our world's fairs, held some years ago. When repairs were needed, it was discovered that this was the only engine of the kind ever built, and the drawings of it were lost; so each repair part called for an accurate drawing.

In the track plan of the works, all the ore, coke, and limestone had to be unloaded from one track. This track also held the cars which were to be unloaded at the oxide crusher as well as at the sulphide mill. The problem of dispersing some of this congestion was not simple. It was solved by building two trestles in place of one; by having the limestone brought in dump cars so that unloading took little time; and by building an oxide-crushing and screening plant on new tracks.—F. D. Weeks in *Trans.* A. I. M. E.

Marketed production of natural gas in the states of New York, Pennsylvania, West Virginia, Ohio, and Kentucky in 1914, amounted to 425,871,728,000 cu. ft., having a total value at the point of consumption of $73,677,641, or an average of 17.3c. per 1000 ft. according to statistics compiled under the supervision of J. D. Northrop of the U. S. Geological Survey. Compared with 1913 the output of natural gas credited to these states shows a slight increase, amounting to 608,480,000 cu. ft., less than 0.2%, whereas the value of the production shows a substantial gain, amounting to $4,359,537, or a 6% increase.

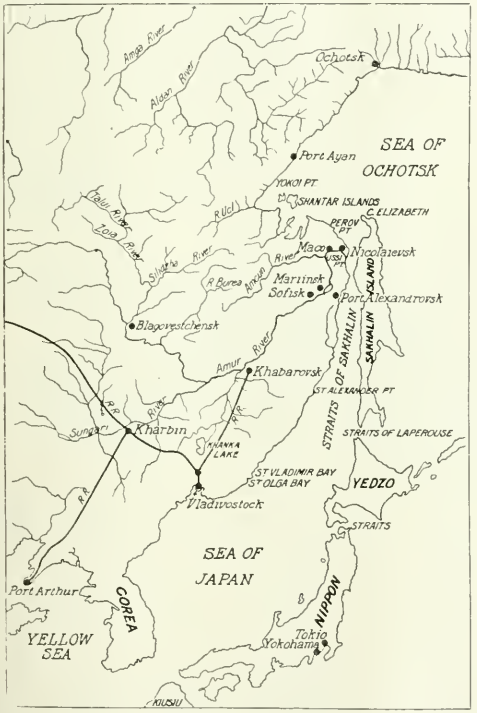
Gold was known in Australia prior to Hargraves' memorable discovery in 1851. But it was the news of the sensational finds in 1851 and 1852 that brought about a constant stream of immigration, and caused an increase of population from 221,000 at the end of 1841 to upward of 1,168,000 at the end of 1861 and which, as one writer aptly phrases it, "precipitated Australia into nationhood."

Dredging on the Amur

By K. I. HLEBNIKOFF

The first, and only, dredge to go to work in the Amur region is the one operated by the Amur Gold Mining Co. It is on the Kharga, a stream that empties into the river Selemdja, a tributary of the Zeya, which, in turn, feeds the great Amur river, the confluence being the town of Blagovestchensk, the residence of the Governor of the Amur territory and the point of export for the gold of Eastern Asiatic Russia.

This region is characterized by ancient sedimentary strata and old intrusive igneous masses, the predominant



rocks being micaceous and hornblendic gneisses. Owing to the excessively wet climate of the country, oxidation has penetrated deeply, especially where the river Zeya with its tributaries has cut through these gneissoid masses and distributed the products of erosion as gravel in the river-beds. The greater part of these rich placers has been worked by natives with the crudest methods, but much of the gravel has not been touched as yet. The fragmentary reports of the Amur Gold Mining Co. show, however, what can be done in this region by dredging.

The dredge was purchased from the Werf Conrad company at Haarlem, in Holland; the capacity of the bucket is 5 cubic feet. The steel pontoon, and all the requirements for the dredge, weighing altogether 505 tons, cost $55,000, including transportation to Blagovestchensk, Eastern Siberia. The machinery was then carried, in the summer of 1913, by steamers on the Zeya to the Norsk factory; then, in winter, from this factory, it was carried on sleighs, along the frozen surface of the Selemdja river, for about 245 miles, to the Zlatuostovsky placer, on the Kharga, at a further cost of $35,000. The various items of expenditure were:

Cost of plant delivered at Blagovestchensk	$55,000
Transport thence to the dredging ground	35,000
Putting the parts of the dredge together in place	10,500
Equipment of the machine-shop	6,000
Building of the new settlement	9,000
Total cost of the dredge and buildings	$115,500

The erection of the dredge was started on January 25 and was finished on the last day of May 1914. Actual dredging started on June 15 and finished on October 15, 1914. During all this time work of dredging proceeded in the bed of the stream and partly along the rims of the same. The following figures show what was done.

Working days	104
Days lost on account of the high water, breakages, etc.	27
Total working hours	2,498
Cubic yardage treated	158,521
Daily average yardage	1,500
Average dredging time daily	19 hr. 49 min.
Average value per cu. yd.	75c.
Ounces of gold recovered	7,554
Value of gold recovered	$120,199
One ounce of gold in Russia is worth	$15.90

To the cost of the dredge should be added the sum of about $22,000 for maintenance during the winter, also fuel, and different repairs preparatory to starting on the second annual campaign, in the spring of 1915.

The grand total cost, therefore is	$137,000
The total gold recovery is	120,199
Showing a loss of	$16,801

The dredge is in operation this summer and naturally will work to better profit than in the preceding year, as there will be no more of the first high costs of purchase and equipment. The dredge is of the New Zealand type.

Filing systems for papers should provide for: (a) Certainty of obtaining a particular paper or of obtaining all the papers relating to a particular subject; and this certainty to be independent of the time that has elapsed since the filing of the paper. (b) Rapidity of obtaining a particular paper or of obtaining all papers relating to a particular subject; and this rapidity to be only slightly affected by the time which has elapsed since filing. (c) Rapidity with which the documents may be filed. (d) Cheapness of operating the system. (e) Simplicity. (f) Reduction to a minimum of the space required for documents. (g) Miscellaneous requirements and desirable features such as numbering, cross-filing, and so forth.

Dycrasite, a silver antimonide, has been found in masses up to one ton weight in the Broken Hill lodes, New South Wales.

Treatment in the West End Mill

During the year 1914, the West End stamp-mill and cyanide-plant, at Tonopah, Nevada, treated 65,351 tons of ore, according to the metallurgist, Jay A. Carpenter, whose report was written recently. The ore averaged $14.02 per ton. An extraction of 89.9% resulted in 11,709 oz. gold and 1,073,241 oz. silver being recovered. This includes company and custom ores. The extraction was a little lower than in 1913, due to the low recovery made on the amalgamation tailing. The mine ore yielded 90.9%; amalgamation tailing, 71.8%; and sand-tailing, 66.66% gross. An average of 25.4 stamps dropped continuously, with a duty of 7.05 tons per day. The direct cost of ore treatment was $2.768 per ton, as follows:

Labor, at an average of $4.50 per shift	$0.724
Power, at 1.45c. per kw. hour	0.506
Sodium cyanide, 2.83 lb.	0.600
Water, 246 gal.	0.185
Cut zinc, 1.34 lb.	0.126
Pebbles, 6.05 lb.	0.105
Fuel-oil, 3.1 gal.	0.121
Shoes and dies	0.026
Tube-mill liners and supplies	0.050
Lime, 2.95 lb.	0.033
Lead acetate, 0.43 lb.	0.037
Other supplies	0.255
Total	$2.768

The following changes in mill-practice are of interest, not only for the saving in cost and extraction, but also as an illustration of the spirit actuating the organization.

The trial of the Komata lining in two of the three tube-mills has shown a good reduction in cost of liners per ton of ore ground. Also, the trial of artificially rounded flints from Manhattan, as a substitute for the Danish pebble in the tube-mills, indicates that a good saving will be made in the cost of pebbles. In the closed tube-mill circuit in the new 10-stamp addition, a screw-conveyor was placed at the sand discharge of the Dorr classifier to carry the sand to the small diameter tube-mill scoop, instead of installing the heavy unbalanced scoop as in former practice. This new design has given excellent results and has been adopted at other mills.

The concentrating department has been handled strictly as an adjunct to cyaniding. For over five months, while the mill was treating a large daily tonnage of $17 ore, the concentrate from the 12 Deister slime-tables was re-concentrated on a Wilfley for shipment down to 0.5% of the ore tonnage, but still containing 14% of the total metal-contents. The removal of this proportion in concentrate reduced the value of the ore entering the agitation department to a point where the length of agitation obtainable made a high total extraction. With a decrease in the grade of the ore in May, the concentrate from the Deister table was pumped back to the tube-mills, making a closed circuit. This method of holding the concentrate back for additional grinding and treatment until it was so finely ground that it escaped with the rest of the pulp to the agitation department, resulted in as great a percentage of extraction ahead of the agitators as in the previous method of concentrate shipment. While the final gross extraction was not as great, the reduction in the marketing cost from 2.6 to 1.6%, gave a higher net extraction. With the reduction to 20 stamps in November, concentration was discontinued, since the ore with longer agitation and finer grinding gave as high gross recovery.

The plan of settling the thin Callow cone-overflow pulp separately from the table-tailing by taking it direct to a Trent agitator, the top four feet of which was used as a settler, while the remaining 14 ft. was agitating thickened pulp, proved very successful and saved additional thickener-capacity for the increase in tonnage, due to 30 stamps.

The Carpenter type of Trent agitator, placed in commission in October 1913, proved so successful that all six agitators have been changed to this style. The only parts subject to wear in the present submerged bearing are a pair of extra heavy pipe-nipples, but the original pair are still in fair condition after 15 months' service. It is now five months since the last agitator was installed and there has not been the trouble of emptying an agitator, and there is no indication that it will be necessary for months to come.

By careful attention to the valves, leaves, and manipulation of the filters during the year, a new low record was made in December of 5.12c. soluble loss per ton of ore in the filter-discharge stream.

The installation of a Tetrault two-stamp battery and concentrating table, both made at the local foundry, has given a neat and efficient method of concentrating the shot silver and matte from the refinery slag.

The United States Steel Corporation has resumed construction work on its steel plant at Duluth. This work was interrupted because of unsettled conditions due to the War, but several hundred men are now working and the plant should be completed by January 1916. The plant will use but a small portion of the ore produced in the district tributary to Duluth and the steamers that carry ore to Cleveland and other lake ports will bring fuel as a return cargo. These are the first steel works to be established near the mines and to which the coal is brought to the ore instead of the usual procedure of carrying the ore to the coal. The market for this plant will be the territory to the west of Duluth, as far away as Montana, and the Canadian prairie towns.

A wrought iron pillar 16 in. in diameter and 23 ft. 8 in. long is one of the great curiosities of India. The method of its manufacture is unknown; even the date when it was made is uncertain and is variously estimated from 319 A.D. to 1052 A.D. The pillar now stands near the Kutub Minar tower a few miles from Delhi.

Arsenic production of the United States last year amounted to 4670 tons, valued at $313,147, an increase of 46 per cent.

Mining Conditions on the Witwatersrand

By W. L. HONNOLD*

GENERAL. †The Rand mines produced gold valued at $166,186,000 in 1914, or say 40% of the world's product. This gold came from 25,701,954 tons of ore; the average yield being about $6.47 per ton. The Rand mining conditions are unique, yet their magnitude renders them of great interest.

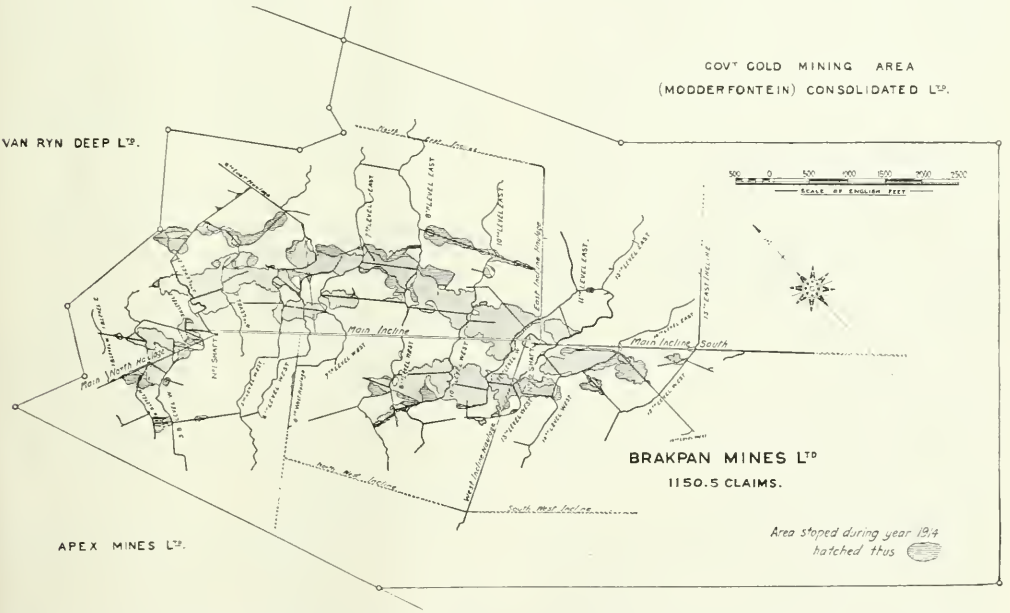
The principal mines are situated along the northern limit of an irregularly shaped geological basin, and extend in almost unbroken continuity over a distance of about 60 miles. As the boundaries are defined by vertical planes there are both 'outcrop' and 'deep-level' properties, all differing in size and in technical features.

Briefly, the ore deposits are profitably enriched portions of certain conglomerate beds, or 'reefs,' rarely more than three, which are interposed between quartzite, or quartzite and slate, and lie so closely together that where more than one are mined they are dealt with as a working unit, although they may be stoped separately. Their collective extension is locally referred to as 'the Reef.'

Along the outcrop the series dips more or less steeply, and in depth it flattens, the latter tendency being most marked in the Far East Rand, where the bottom of the basin is nowhere so deep as to be inaccessible.

Dikes and faults are a common feature throughout. They are, however, so well understood as seldom to involve mistaken procedure, although they may occasion delay and added expense.

The pebbles are mostly of rounded quartz, averaging perhaps less than an inch in diameter, cemented together by a fine-grained quartzitic matrix of metamorphic character. Sedimentary inconstancies, including partings of quartzite, are in evidence, and more or less pyrite is interspersed, which may or may not be appreciably auriferous. Native gold occurs in varying amount, constituting on the average perhaps more than half the assay value of the orebodies.



In my opinion "the average quantity of gold per unit of reef-area lessens in depth." The beds vary in thickness from a few inches to 10 ft., averaging 33 in. The uniformity of the Leader [one of the seams of gold-bearing banket or conglomerate] is remarkable; it has been stoped almost continuously for a length of five miles on the Central Rand and has been worked on the dip to about 7000 ft. from the outcrop. While in the Central Rand the Village Deep mine has reached a depth of 4600 ft. at a horizontal distance of 7000 ft. from the outcrop,

*Lately consulting engineer and managing director of the Brakpan and other mines in the Far East Rand.

†Abstract of a paper to be presented at a meeting of the American Institute of Mining Engineers, to be held in San Francisco, September 1915.

and the dip in the lower levels is nearly 40° with a steepening tendency, in the Far East Rand the Brakpan mine has only reached 4100 ft. 4 miles from the outcrop and the local dip is but 7°. The Springs mine 3½ miles from the Brakpan is 3750 ft. deep 7 miles from the outcrop; in this mine the ore is exceptionally rich, averaging 10.3 dwt. over an assumed stoping width of 52 inches.

The Village Deep mine shows stoping ore of better grade than the average of the mine for a length of 5000 ft. on the lower level. The orebodies in the Brakpan extend, in some cases, over 700 ft. on the strike and 4000 on the dip, their grade being about the average of the Rand, say $7 per ton.

Imported supplies are expensive: timber $1 per cubic foot, drill-steel $150 per ton. Local coal is cheap, $2.80 per ton. Electric power costs about 1c. per kilowatt-hour.

The daily wage of the white underground employee, whose work is mainly supervisory, averages about $5, while the native, who does all the hard work, gets about 50 cents; the native also receives housing, food, and medical care; adding cost of recruiting and transportation makes the total cost to the company about 75 cents daily.

The Brakpan Mine is one of the most important mines that has been developed in recent years. Its remoteness from profitable mines rendered it a speculative venture; even after $188,000 had been spent on bore-holes and preliminary work, its future was problematical. During 8½ years $5,772,000 was spent in developing the property before milling began. Perhaps no mine that has been opened on the Rand gives more hope for the future of the local mining industry.

The property measures 6000 by 14,000 ft. and is opened by two shafts each 42 ft. x 9 ft. over all. No. 1 shaft reaches the lode at 3098 ft. and No. 2 shaft, distant 4500 ft. on the dip, at 3707 ft. Full descriptions of these shafts were given in the Mining and Scientific Press of April 26 and May 3, 1913.

The No. 2 shaft has four compartments for hoisting; the 3-deck cages take 60 men; the shift of 110 white and 1650 natives is hoisted in 2 hours by a 2100-volt motor of 1450 hp. About 150 tons per hour is handled over a vertical distance of 3850 ft. at a cost of 17c. per ton for 64,000 tons monthly. The main incline connecting shafts No. 1 and No. 2 is 4500 ft. long, 18 ft. wide, dip 7°. Driven from both ends the horizontal error at the meeting-point was 6.5 in., and the vertical error 0.7 in. In a flat orebody, such as that exploited in the Brakpan, minor undulations and faults cause crooked drifts and make development and tramming more costly than in a steep-dipping deposit. The levels are 6 ft. x 7 ft., main haulage ways 14 ft., secondary haulage ways 11 ft. wide. Governmental regulations having forbidden the former practice of first blasting the cut and then the round, after spraying the face with water for 30 minutes, each miner is now given two faces of work, which he blasts on alternate shifts. The cost of drifts in 1914 was $15.87 per foot; haulage-ways cost $25.60 per foot.

Small drills of the hammer type with hollow steel promise in time to replace the larger drills both for stoping and driving. The large drills break 11 tons per shift, the small drills 7 tons; the stoping-width is 70 in. and 57 in., respectively. This poor showing is due to labor conventions that restrict the work of each machine to drilling four holes per shift, each 6 ft. deep. In opening a stope, work is usually started at both the bottom and top of the winze, which, as already noted, is 9 ft. wide. A winch is placed at the top to deal with the upper portion of the stope, and another half-way down to raise and lower the trucks that serve the bottom section by way of the level below. The benches at first conform to diagonals from the winze to the levels, giving the appearance of underhand stoping at the top of the winze and overhand at the bottom, but after reaching a distance of about 100 ft. on either side their lateral extension is checked and they are advanced mainly in the direction of the winze until the stope is opened throughout. Each face is then more or less parallel to the winch track, from which laterals have been thrown off at intervals of 35 ft. for extension as required. 'Backs' vary from 300 to 1200 ft., according to the influence of dip on the distance between levels. Stope-pillars of good size are left where necessary, especially along fault-lines, and these, together with frequently placed 'pig-sty' packs, sufficiently support the roof. As the faces advance right and left the roof of the interior gradually subsides, the weight being taken by the packs. This may or may not call for the shifting of winch-tracks.

The cost of stoping during 1914 was, for large machines 98c. per ton broken, and for small machines $1.20. After allowance for the included ore from development faces and other sources, and for the waste-rock discarded in sorting, the general average was $1.03 per ton milled.

Shoveling and tramming of the ore in the stopes costs 68 cents per ton. Haulage is by an electrically-driven endless rope and costs 10 cents per ton for the 707,575 tons hauled in 1914.

Ore reserves are computed once per annum. The correct estimation of stope-width is of great importance. The flatness of the lode and the use of machine-drills seldom permit of a height less than 48 in., and this is taken for a minimum. As a whole, the stope-width exceeds the average lode-width by 22 inches.

A typical calculation of the value is:

			Dwt. per ton.
	73	From ore reserve	6.7
	17	From development	2.8
	10	From other sources	5.6
	100	to sorting plant	5.98
Deduct	14.5	excluded by sorting	
Deliver	85.5	to mill	6.93
Recovery, with 96% extraction, say,			6.65

Clearly, any variations in the assumptions would correspondingly affect the result. It is necessary, therefore, in making a forecast, either to put forward a definite figure as a measure of existent conditions in the light of probability, or to give limiting figures sufficiently comprehensive to cover the contingencies that may arise.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Cost of making aluminum is approximately 18c. per pound.

The front head of a machine-drill receives the hardest wear and the roughest usage of any part.

Canvas air-pipes have been satisfactorily used for ventilation at the Nourse mine on the Rand.

Aluminum in the United States is produced by the Hall process; in Europe by the Heroult system.

Electric furnaces for smelting iron ore are only of advantage in localities where charcoal and coke are expensive, and where electric power is cheap.

The metal cobalt is considerably harder than either iron or nickel under similar conditions. Its melting point is 1467°C., and tensile strength 34,400 lb. per square inch.

Electricity in metallurgy, apart from refining processes, is used in the manufacture of aluminum, ferro-alloys, pig-iron, and steel; also, to a limited degree, in electric-furnace smelting of copper and zinc ores.

Electric-lighting fixtures about mines must be safe; not only safe under ordinary conditions, but with sufficient insulation and mechanical strength to allow continuity of service under unusual electrical disturbances or mechanical strains.

Gypsum is found in various places in Australia. It occurs as large crystals, and also in minute crystals forming a floury earth known as 'copi.' Both forms are exceedingly pure. It is used as a natural manure and in the manufacture of portland cement.

Cargo-sampling of iron ore is done by taking a sample from the top of the cone under each hatch, and then sampling each exposed face when the cargo is unloaded. By this method the results are high if the last material loaded into the vessel is richer than the average.

Cryolite, a source of aluminum, used also in making soda and glass, is not produced in the United States. The entire supply used in this country is imported from Ivigtut, an Eskimo hamlet on the southern coast of Greenland. The quantity in 1914 was 4612 tons valued at $94,424.

Salt occurs naturally in two distinct ways, as rock-salt in beds or associated with bedded or sedimentary rocks, and in the form of natural brines or bitterns. It is prepared for market by simply mining, crushing, and cleaning the rock-salt, or by evaporation. The latter process may be either natural, as when the sun's heat is utilized, or artificial, when steam or direct heat is applied.

Pneumatic-tools should be kept clean, well lubricated, and limited to the uses for which they are intended, otherwise they will not give the service for which they were designed. The supply of air should be clean, cool, and dry. Some tools require a light machine-oil, and others a heavy grease. It is a good plan to immerse pneumatic-hammers in a bath of kerosene or benzine over night, and then blow them out next day, followed by lubrication.

Acetylene gas is not poisonous, but, like nitrogen, will not support life. One great advantage of acetylene is that it does not make smoke or soot. The spectrum of acetylene discloses the fact that it is the closest approach to sunlight of any of the illuminants. Up to the present no safety-lamp, using acetylene as a source of illumination, has been devised for gaseous mines, but in non-gaseous coal mines it is safe to say that 70% of the miners are now carrying acetylene lights.

Limonite in pisolitic form, an aggregation of concretions, the size of small peas, is found in many localities, but the occurrence of separate spheres of limonite is not so common. They are, however, found in Switzerland, also in the Province of Shansi, China, where they are called iron peas, and the water in which they are boiled is considered a specific for rheumatism. This Chinese superstition is paralleled by many Californians who are paying a dollar for a few ounces of insoluble minerals employed in a somewhat similar manner.

Coorongite, a mineral substance resembling india-rubber, is found near Kingston, in the Coorong district of South Australia. Soft, semi-elastic, with a tarry smell, somewhat reminiscent of Russian leather, it very closely resembles some of the crude African rubbers and would not be taken for a mineral product. An analysis gave C 64.73, C (fixed) 1.00, H 11.63, O 20.38, H_2O 0.47, ash 1.79 = 100.00. Retinite, a brilliant black resin and a pure white paraffin are also found in this same locality. It was thought that these substances originated in oil-bearing strata, but so far no petroleum has been found.

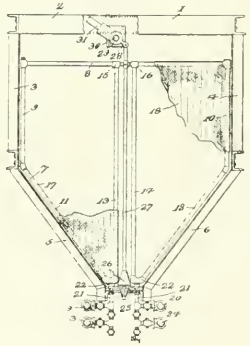
A drag-line excavator may be moved when working on soft material as follows: The drag-lines are operated on four platforms. When a machine is ready to move, and the platform in the rear of it is swung and dropped in place in front of the machine in the direction in which it is desired to move, the drag-line is swung facing the rear. A 20-ft. chain or cable is hooked by means of a clamp on to the platform which has just been dropped in front of the machine. This cable is run under the base of the excavator, and the other end is hooked through the bucket-chain. When the bucket is hoisted, the machine moves ahead easily in the direction desired. With this method, the machine is ready to dig in five minutes.

Recent Patents

Process for the Recovery of Metals from Ores and the Like. Charles S. Vadner, Salt Lake City, Utah. Filed August 7, 1914. Serial No. 855,713.

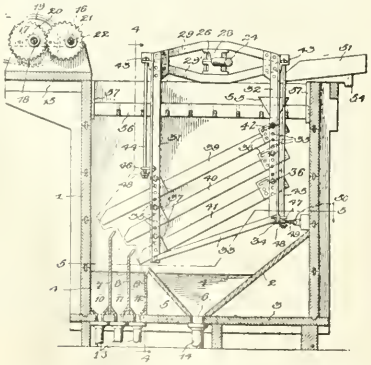
1. A process for extracting metals from mineral matter and the like consisting in treating the mineral matter with smelter fumes and the like containing sulphurous gases in the presence of a solution containing at least one of the common chlorides leaching out the metals from the mineral matter, eliminating excess SO_2 gas by suitable means, passing air through the solution thereby precipitating iron, eliminating and recovering the iron.

Filtering Apparatus. William E. Holderman, Salt Lake City, Utah. Filed June 26, 1913. Serial No. 775,987.



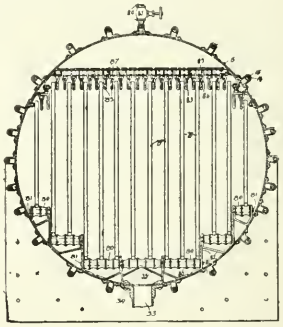
1. In a tank, a filtering partition within said tank comprising an angular framework of perforated piping divided longitudinally into two sections, the top pipe of the framework being common to both sections, cover of filtering fabric stretched across each frame, and means for causing a flow of fluid into and from said partition.

Ore-Concentrator. Fritz Oscar Stromborg, Salt Lake City, Utah. Filed March 26, 1914. Serial No. 827,416.



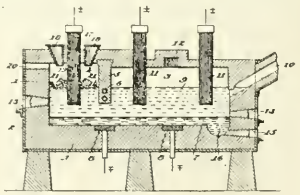
1. The combination of a water tank, a crank shaft revolubly mounted on said tank and extending there across, a substantially rectangular frame supported by said crank shaft, said frame having a pair of oppositely bowed cross bars at its opposite sides, a sectional bearing secured between each pair of cross bars and through which the eccentric portion of said crank shaft passes, hanger bars rigidly secured to and depending from the corners of said frame, bars connecting the lower ends of said hanger bars and thereby forming a rigid frame depending into the tank, screens adjustably mounted on said depending frame, and means for imparting movement to said frame.

Filter. William Poole Lass, Treadwell, Alaska. Filed September 30, 1912. Serial No. 723,064.



1. In a filter, a drum, a plurality of supports on the inner face of the lower portion of the drum, said supports consisting of a set of spaced brackets at each side of the centre of the drum, means connecting the adjacent brackets of the sets together at the top of the brackets, and means connecting the top of each bracket of each set of brackets, with the bottom of the next adjacent bracket, a plurality of filter leaves resting upon the supports, and guides in the upper part of the drum and between which the upper ends of the leaves extend.

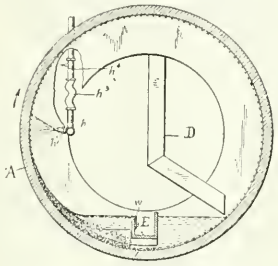
Process of Treating Zinc-Bearing Materials. Woolsey McA. Johnson, Hartford, Connecticut, assignor to The Continuous Zinc Furnace Company, Hartford, Connecticut, a corporation of Connecticut. Filed June 27, 1913. Serial No. 776,185. Renewed December 10, 1914. Serial No. 876,538.



1. A cyclical process of treating a charge of zinc-bearing material low in sulphur and containing silica, which consists in electrically heating the said charge in presence of molten iron, producing thereby metallic zinc and a ferruginous silicate slag, condensing the evolved zinc vapors, recovering iron from the said ferruginuous silicate slag, and utilizing the reduced iron to reduce further quantities of zinc-bearing material.

Concentration of Minerals by Flotation. Archibald R. Livingston, Canon City, Colorado, assignor to The New Jersey

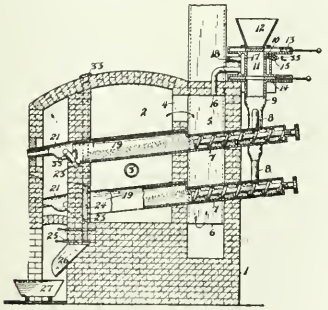
Zinc Company, New York, N. Y., a corporation of New Jersey. Filed December 27, 1913. Serial No. 808,945.



1. The method of separating floatable minerals from material with which they are associated, which consists in feeding the mixture into a body of water, progressively raising it through the surface of the water, meeting the emerging top layer by a downflowing film of water, and floating the top layer thereby into the main body of water at the surface thereof and collecting the material thereby separated separately from that which sinks; substantially as described.

2. The method of separating floatable minerals from material with which they are associated, which consists in feeding the mixture into a body of water, progressively raising it through the surface of the water at an angle greater than its natural angle of repose, lowering the angle of repose of the emerging top layer by a down-flowing film of water and floating the top layer into the main body of the water at the surface thereof and collecting the material thereby separated separately from that which sinks; substantially as described.

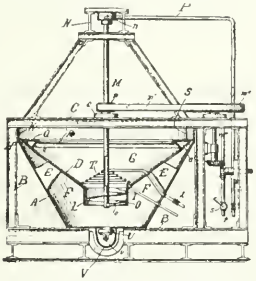
Method of Smelting Zinc and Other Ores. James M. Hyde, Berkeley, California. Filed March 10, 1915. Serial No. 13,377.



1. The process of smelting zinciferous materials which consists in mixing with the zinciferous material a proper amount of reducing agent, charging the same into a retort while preventing the passage of vaporized zinc, through the charging device, vaporizing by external heat the zinc in the retort, and separately removing the vaporized zinc and the solid residues from the retort while continuing the smelting operation, and preventing the passage of gas out of or into the retort through the opening through which the residues are withdrawn.

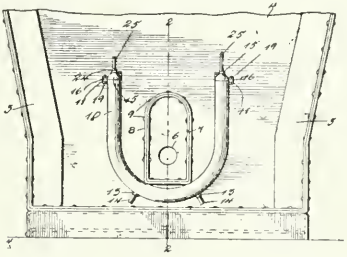
Cyaniding Apparatus. Frederick E. Carman, Jamaica, New York, assignor to Miriam E. Carman, Babylon, New York. Filed October 22, 1912. Serial No. 727,093. Renewed December 22, 1914. Serial No. 878,610.

1. In a cyaniding tank, a receptacle having the form of an inverted frustrum of a cone, a partition having the form of an inverted frustum of a flatter cone and secured within said receptacle to afford outer and inner compartments communicating at their upper peripheral portions and at their lower central portions, and means for creating a current of liquid



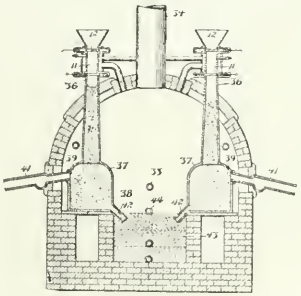
downwardly within said inner compartment and upwardly within said outer compartment; substantially as described.

Water-Jacket. Eulalio Medina, Douglas, Arizona. Filed December 31, 1914. Serial No. 879,942.



1. A water-jacket of the class described comprising a U-shaped hollow body, said body being adapted to be supported adjacent to a tap opening of a blast furnace, said water-jacket having open upper portions and a plurality of detachable caps secured to the upper portions of said water-jacket for closing the open portions, and means connected to said water-jacket and to said caps for maintaining a circulation within said water-jacket whereby the water-jacket will remain in a chilled condition.

Zinc-Smelting Furnace. James M. Hyde, Berkeley, California. Filed March 10, 1915. Serial No. 13,376.



1. A furnace for smelting material containing a volatilizable substance having a heating chamber, a smelting vessel or retort within the heating chamber having an outlet for the removal of volatilizable metal and an outlet for the removal of molten material, a chamber into which said latter outlet discharges, and means whereby said molten material seals against the passage of gas the communication between the latter chamber and the smelting vessel.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

NEW YORK

EXPORTS.— IRON TRADE.— METALS.— PARAFFIN.— ALUMINUM.— COAL.—MUNITION PRODUCTION.—AMALGAMATED COPPER.

Discussion on the War has given place to that on exports. Never was so much interest taken in exports, foreign opportunities, and strange unheard-of places. The significant point about many American businesses at present is change. Firms that formerly scorned foreign trade, with its misunderstandings and long credits, would today be entering bankruptcy if it were not for the unprecedented orders from Europe and South America. Large concerns that had begun to lose faith in big business, on account of reactions and changes in sentiment are as active as in previous prosperous times. Oddly enough, certain miscellaneous insignificant lines of American trade or production are looming up as never before, and making profits they never expected, while a few standard lines of business are dwindling to nothing, being hit instead of benefited by the War.

Aside from the naturally-expected extraordinary increases in the export of food-stuffs, including an enormous expansion in wheat and meat, the most far-reaching and significant gain is in the growing demand for iron and steel goods. A few months ago the iron and steel trade was very slack, with mills and mines at around 50% capacity. Now they are climbing to full capacity. From Coleraine, Minnesota, among the great pits of the Mesabi range, to Woodstock, in the desultory, lonepine areas of Alabama, iron mining is reviving. And at blast-furnaces, steel-mills, and foundries, all over the East and Middle-West, night shifts are at work. Iron and steel manufactures, the exports of which totaled $38,000,000 less for 11 months ending May 31 than in the corresponding period of the previous year, amounted to $26,500,000 for May 1915, compared with under $20,000,000 for May 1914. This shows the trend of events. At the same time it is rather surprising to many people to learn that exports of copper have been consistently for months below normal, in May 1915, $9,800,000, and $11,700,000 in May of last year. The decline is largely due to Germany being cut off. The demand for mineral oils for export is gradually reviving. Exports of zinc in May were worth $2,400,000; this is nearly all gain over normal conditions. It may be remarked that the foreign demand for American zinc, lead, coal, oil, and copper, is more than equaled by the great value exported in such commodities as cars, carriages, autos, trucks, horses, mules, etc., while a host of minor material such as paraffin, wire, boots, cotton-seed oil, aeroplanes, wool, chemicals, tobacco, etc., have sprung into amazing importance. Of interest to miners it may be noted that illuminating the trenches of the European battle-fields partakes of much the same nature as lighting a mine, and the export item of $5,600,000 for paraffin, for five months (December to April), compared to less than half the amount in the same period of the previous year, was increased largely by the use of candles in the trenches. It is presumed that miners' acetylene lamps are favored by the officers, but the ordinary soldier, like the ordinary miner, (sometimes the same man), understands a candle without any explanations.

The export of aluminum has been given a spurt by the unusual conditions of the War, due not only to its substitution for copper which is so costly at present, but also on account of its value where lightness is essential for aeroplanes, soldiers' kits, etc. The Aluminum Co. of America is in a position to supply a large output from its enlarged plants. It has just finished large additions to its plant at Massena, St. Lawrence county, northern New York, where plenty of power for electric smelting of the bauxite ore is obtained from a system of canals across good-sized tributaries of the St. Lawrence river. From a scale of exporting of little more than $1,000,000 per year, aluminum is now leaving the country at several times that rate.

Over in the Naugutuck valley of Connecticut there is great activity. At Bridgeport, Waterbury, New Haven, and Hartford, arms and ammunition factories are 'growing' over night, and more land and buildings are being acquired. Twenty-four hours per day is worked; machinists and mechanics are in demand; towns are doubling in size. Business is so good that the workmen would strike if they had time to plan a decently vindictive strike and to concoct some grievances. Pins, watches, corsets, etc., are temporarily forgotten in the zeal for making war munitions. Concrete walls surround the factories, and earthen bulwarks the fulminate buildings, the former against cranks, the latter against explosions. At powder factories in the little state of Delaware, similar scenes of activity, expansion, and explosives, are seen; the Du Pont family (with the exception of General T. Coleman Du Pont, who sold out recently and went in for life insurance) has had its fortunes greatly enhanced. One authority thinks that Americans who usually spend their summers and money in Europe are procuring excitement in the astounding turns which home business is taking, speculating in and guessing at the unprecedented twists that war and foreign conditions bring. Another authority ventures the assertion that such a change is doubly beneficial for American industries and businessmen, because it gets them out of the rut of 'thinking only of what's under their noses,' that is, the new order tends toward a cosmopolitanism, that even New York knew little of a year ago.

The following partly shows the exports for the five months, December-April, and also shows the trend of European buying in the United States when the magnitude of the War became first appreciated:

	1913-1914.	1914-1915.	Increase.
Horses, mules, harness, etc..	$ 2,393,970	$60,267,925	$57,873,955
Auto-trucks and auto tires..	1,629,246	21,250,708	19,621,462
Machine-tools	5,803,039	15,024,659	9,221,620
Lead	450,887	3,999,150	3,548,263
Zinc and manufactures.....	129,786	9,582,459	9,452,673
Brass and manufactures....	3,286,034	10,076,530	6,790,496
Aluminum and manufactures	537,044	1,706,766	1,169,722
Leather and manufactures..	14,546,256	33,908,078	19,361,822
Chemicals	3,885,151	12,111,946	8,226,795
Men's boots	4,177,100	8,535,601	4,358,501
Explosives	3,474,064	16,685,255	13,211,191
Firearms	1,426,256	4,845,238	3,418,982
Wool manufactures	1,864,143	16,636,288	14,772,145

It will be noticed that many items are larger than those of explosives and firearms, that the increase in explosives is less than the increase in horses, auto-trucks, leather, or woolens, while firearms increased less than nearly anything else. It is true, of course, that many factories had not yet got into swing on explosives and firearms, and that the export record for the remainder of the year will show a decided increase in these items.

Relative to coal conditions, this business was very dull during the early months of the year, due to general industrial depression and to the slump in bunker-coal. A little foreign

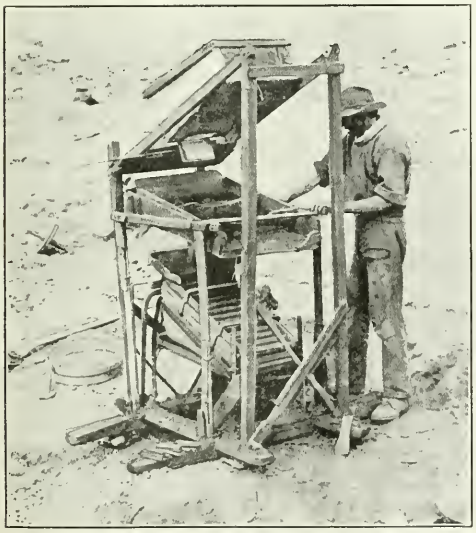
trade has been secured. The May export of coal was $5,800,000, compared with $5,200,000 in May 1914. Another reason for the slow expansion of American coal trade abroad is the undoubted consideration that however clever Americans may be as salesmen in their own prosperous country, and however ingenious in handling low-grade minerals in large quantities at low cost, when it comes to selling a product in Latin countries which those people can possibly get along without, the average American knows little of how to proceed. A little coal is being shipped to South America and the West Indies. Probably of more interest to coal miners is the industrial revival which is now calling for coal throughout the United States, such that, with the iron trade brisking up and factories booming, bituminous coal sales are slowly improving.

It is fitting at this time to say a word about the passing of Amalgamated Copper Co. It was incorporated in 1899 and dissolved in 1915, and was unsuccessful in its main purpose, the domination of the copper industry of the world.

KALGOORLIE, WESTERN AUSTRALIA

Rain and Activity in Prospecting.—Great Boulder Drilling.—Edna May Mine Developments.—Labor Inconsistencies Again.—Beria Consols.—Ivanhoe at Depth.—South Kalgurli.—Gold Yield and Dividends.

The abnormally wet season continues, the rainfall in June being 3 in., making a total of 13.78 in. for the year to date, against an average of 8.9 in. for the previous seven years. The



A WESTERN AUSTRALIAN DRY-BLOWER AT WORK.

highest fall in this period was 12.68 in. (in 1909), and the lowest 5.08 in. (in 1911). Owing to the abundance of water everywhere prospectors have shown great activity in various directions. The greatest drawback to prospecting is the damp surface loam and gravel, making 'dry-blowing' impossible. They have been well backed by Melbourne, Victoria, speculators, and to a lesser extent by those of Adelaide, South Australia, and Perth, Western Australia. So far fully 30 small syndicates and companies have been formed to develop the discoveries. It is too soon to say whether anything persistent has been found. ——At Gibraltar, 16 miles southwest of Coolgardie, the Lloyd George, now held by a Perth syndicate, and the Bulla Bulling, under option to Melbourne people, have produced 16 tons for $960 and 4 tons for $2060, respectively, from small holes. The ground is being opened.——At Grossmount, 6 miles nearer Coolgardie, a large number of areas have been located. Several prospectors have had rich crushings, but only one property looks like becoming a mine. This is held by Nioa and others who have had several lots treated at the Government mill at Coolgardie, 10 miles distant. Returns averaged 3 oz. per ton. The lode in this claim consists of decomposed schist up to 10 ft. wide, but only 3 ft. on the foot-wall is being stoped at a depth of 30 ft., as the transport and crushing absorb $5 per ton, and the cost of treating the residue is $3 per ton, in addition to 75% gold recovered.——At Mungari, 11 miles northeast of Coolgardie, two prospectors, named Penglaise, unearthed 500 oz. in a hole 2 ft. deep. They are apparently afraid to sink deeper, remembering the Londonderry and Wealth of Nations fiasco of the early days. The specimens exhibited in Coolgardie remind one very much of these wonderful finds.—— From Laverton, 211 miles northeast of Kalgoorlie, the Westhead Bros. have treated at Kalgoorlie 35 tons for 375 oz., in addition to 345 oz. recovered by pestle and mortar. They expect to get another 70 oz. from the residue. The bullion is worth $19.80 per ounce. At the time the specimens were found, at a depth of 50 ft., the mine was on offer to Sir Alexander Peacock, Premier of Victoria. He promptly closed the deal, and it is officially reported that there has already been recovered 500 oz. within a week of paying a first deposit of $2400.——New prospects have also been reported from various districts on the Murchison field. Owing to the general use of automobiles, investors and promoters are enabled to examine any new claims soon after they are reported, instead of being handicapped in transport as in the early days.

Although numerous boreholes, covering a distance from north to south of 1200 ft., put in from the Perseverance, have cut ore in Great Boulder ground, Richard Hamilton shows no inclination properly to test the two lodes located by crosscutting and driving on them. Boreholes have now cut the lodes at seven different levels from 900 to 2200 ft. with varying results, in many instances in high-grade ore. Reserves are estimated at 627,900 tons assaying $13.62 per ton. No sinking has been done for four years.

After the cross-cut at 300 ft. in the Edna May had been driven 69 ft., 600,000 gal. of water daily started to flow. This is quite beyond the capacity of the 8-in. Cornish lift, and all work underground is stopped while bailing to assist the pump is being resorted to. The manager, M. Williams, recommends the installation of a steam pump at the 300-ft. level, but steam pumps are not satisfactory. Gold production may be largely reduced for the time being, and possibly the payment of the monthly dividend may have to be suspended. Ore reserves are estimated at 84,000 tons for the three levels opened. Of this total, 54,000 tons, yielding $1,178,690, equivalent to $21.83 per ton, has been treated. This would only leave 30,000 tons in reserve, and yet the directors have ordered additional treatment plant at a cost of $42,000, in order to increase the monthly output to 5000 tons, or 2000 tons more than hitherto. The mine has been a wonderful one so far, but should the water difficulty not be quickly surmounted, the upper levels, if they can be kept drained and stoping can be continued, are likely to be seriously depleted, and the increase in milling plant may be found unnecessary.

Owing to the Murchison Miners' Union prohibiting contract, or bonus, work, the Kyarra mine at Meekatharra has been closed down, and 65 employees have been paid off. In September 1914 the sinking of the main shaft below the 300-ft. level was let on contract, but the Union vetoed this, and the contractors stopped work. After suspending shaft-sinking for seven months, the management arranged in May to pay standard wages with a bonus for extra footage. Under this system the weekly progress was at the rate of 7 to 8 ft., the average cost being $43.20 per foot. The Union, after the first week,

interfered, and prohibited its members from continuing to work on the bonus system. Day labor was then tried, and the weekly advance dropped to 3 ft., while costs rose to $129.60 per foot. The shaft has now been stopped at 328 ft., or only 18 ft. below what it was when sinking was resumed in September. The same Union caused a stoppage on the Yuanmi mine for 68 days, in 1914, by dismissing from the Union 12 men who were sinking the shaft on contract, and then refusing to work with them for being non-unionists. Afterwards they stultified themselves by allowing the work to be done on the bonus system, which they now refuse to allow on the Kyarra in the same district.

The Lancefield, now known as the Beria Consols, has been registered as a limited liability company, with a nominal capital of £50,000 in £1 shares. The directors are F. A. Moss, formerly manager of the Kalgurli; G. Ridgway, late engineer of the Great Boulder Prop.; and A. Porter, managing director of the Kalgoorlie & Boulder Firewood Co. The treatment-plant has been thoroughly overhauled and brought up to date under the supervision of Mr. Ridgway, and it is expected to treat 6000 tons per month with a good extraction and profit. This plant has now been running three weeks and all necessary adjustments have been made to ensure its future proper operation. In the past the mine has produced 572,780 tons for $4,579,800, or, say, $8 per ton. Ore reserves are estimated at 250,000 tons assaying $8.16 per ton. This quantity can be materially increased by the further opening of the bottom levels. The deepest level is at 1000 ft. or the incline, which is only 40°. The ore-shoot in the upper levels is 1200 ft. long, and averages nearly 20 ft. wide.

The Ivanhoe ore reserves are estimated at 998,700 tons averaging $8.94 per ton, or 32 months' supply for the mill. The main shaft is down 3320 ft. A diamond-drill bore from that point penetrated the East lode at a vertical depth of 3457 ft., 189 ft. east of the shaft. The width was 78 in. and the assay-value $7.74 per ton. This development appears to confirm Malcolm Maclaren's theory that the lode and gold-content would again be found below the porphyry bar.

The South Kalgurli's reserves are given as 250,450 tons of an assay-value of $5.94 per ton, equivalent to 26 months' supply for the mill. A short ore-shoot, averaging about $5 per ton, has recently been opened between the 800 and 1000-ft. levels of the Hainault part of the property, but the quantity developed is not sufficient to affect materially the general average value of the mine.

In the *Monthly Journal* of the Chamber of Mines of May 31, the new Federal tariff, which affects the mining industry, is discussed editorially. Higher duties have been imposed on 40 items of importance. The future of mining in the State is discussed by W. A. McLeod, of Bewick, Moreing & Co. Systematic prospecting, aided by the Geological Survey, is necessary.

In Bulletin 18 of the Aust. I. M. E., V. F. Stanley Low discusses the low-working costs of the Corinthian North mine and mill in the Southern Cross district. Total charges are only $2.36 per ton.

The gold yield of the State in April was $2,179,280 and $399,000 in dividends; in May these were $2,201,810 and $54,640, respectively.

MANILA, PHILIPPINE ISLANDS

Benguet Consolidated Mill.—Re-Opening Coal Mines.—Dredging.—Drainage-Adit.—Hydraulicking.—Cement Manufacture.—Iron Ore.—Rock-Asphalt.

The Benguet Consolidated Mining Co. received the last of the machinery necessary to complete its new 10-stamp mill near Baguio, Benguet, on the *Tacoma Maru* which arrived here on July 6. Rain is due any day now, and every effort is being made to transport the material over the Benguet road, which is usually more or less impassable during the rainy season. The new plant is complete except for motors and transformers. Adequate supplies of cyanide and zinc have been secured to last through the rainy season. The company is in a position to operate continuously even though communication with the outside world is cut off by floods.

The resumption of coal mining is promised by the lease of the old Insular Coal Co.'s property at Danao, Cebu, to J. J. Shaw and J. Clyde Nichols. The former made the installation of the hydraulic plant on the Cansuran Mining Co.'s property in Surigao; the latter is a mining engineer who has been in the Philippines for several years. There are four beds of a good grade of sub-bituminous coal at Danao, about one meter thick. A light railroad connects the old mines with the coast at Danao, a distance of about 10 kilometers. This line is being overhauled, a small dock is being built at Danao, and some of the old workings are being re-opened. It is planned to start operations in a small way, the initial daily production to be about 10 tons. The output will be distributed from Cebu, an open port. Inter-island shipping concerns could arrange to take on coal at Cebu. This would make a market for an output larger than that contemplated for the present. As the re-opening of the old pits proceeds, the yield is expected to increase to about 300 tons per day.

There is a movement on foot to re-open the coal beds on the Escaña property at Compostela, several kilometers south of the mines at Danao. The Compostela coal is comparable in quality with the Danao coal, and mining conditions are similar. There is no communication from the Compostela region to the coast at present, other than by foot-trails.

The Malaguit Dredging Co. has taken out papers for a corporation capitalized at ₱1,125,000. Judge Frank B. Ingersoll of Manila is general manager of the company. His brother, residing in Seattle, Washington, is one of the principal shareholders. The company has a new modern dredge, built by the Yuba Construction Co., California, and has been operating successfully for a year or more, on the Malaguit river, Camarines.

The San Mauricio Mining Co. has let a contract for the driving of an adit to unwater the old workings near Mambulao, Camarines. The proposed opening will start from a point north of the town of Mambulao, just above sea-level, and will drain the mine to a depth of about 250 meters below the collar of the main shaft. The length of the adit as planned will be nearly 2000 meters. The formations to be penetrated are schist and gneiss. Inasmuch as the adit will be directed across the strike of the principal known veins, and will cut these considerably below the deepest former workings, it is expected to yield valuable information. The contract has been awarded to A. C. Cavender; work will begin immediately. A small air-compressor is being installed, and machine-drills will be used in the excavation.

Some Manila mining men have secured a lease on placer ground on Cabu river, in Nueva Ecija province. An attempt is being made to sluice a part of the area. The gravel is washed down by means of a small pressure-pump, pipe-line, and 1-in. nozzle, into a sump, from which it is elevated to the head of the sluices. The presence of gold on Cabu river has been known for many years, but this is the first attempt at mining. The gold is well rounded, and small nuggets are not uncommon. The ground has not been thoroughly tested, and it is impossible to give the value. The present work is really in the nature of exploration.

The Mambulao Placer Co. has received the first shipment of material for its new dredge to be built at the head of Mambulao bay, Camarines. The New York Engineering Co. has the contract for this boat, which will be similar in design to the dredge built by the same firm for the Gumaos Placer Co., three years ago. The new one will embody certain improvements, however, designed to facilitate the handling of large volumes of barren clay overburden.

The Rizal Cement Co., Binangonan, Rizal, began burning

cement on July 1. This plant was purchased complete from the Krupp works at Magdeburg. It has a single rotary-kiln, 34 meters long and 2 meters diameter, and will produce about 500 bbl. of cement daily. Power is generated by Locomobile engines. Grinding both the raw ingredients and clinker is done by ball and tube-mills. The installation includes an aerial tramway 7½ kilometers long, from quarry to mill. This line, as well as the mill machinery, was purchased in Germany, and the installation has been entirely in the hands of German engineers. The raw materials at Binangonan are a pure, crystalline limestone and a fragmental andesite-tuff.

A recent *Press Bulletin* issued by the Bureau of Science, Manila, summarizes the results of the official survey of the Surigao iron-ore deposit. The estimates specify a total quantity of 500,000,000 metric tons of ore distributed over an area of approximately 100 square kilometers. Over 400,000,000 tons are so situated as to afford possibilities for mining. About 275,000,000 tons are fairly accessible from the coast, and 130,000,000 tons lie within a comparatively short radius of Dahikan bay, which affords natural harbor facilities and at which a base of operations might be established. The ore occurs as a mantle of limonitic c'ay overlying serpentine. It is a residual decomposition product, and is thus similar in character to the Mayari iron ores in Cuba. The Surigao ore, after sintering, would contain from 53 to 54% of metallic iron, allowing for 3.5% of re-absorbed moisture. It is free from both phosphorus and sulphur. Like the Mayari ore, it contains a little chromium, but nickel, which is present in proportion of about 1% in the Cuban ore, has not been detected in the Surigao ore. The country in which the ore occurs is semi-mountainous, and the deposit is separated into distinct areas by numerous deep cañons. While a great deal of the ore is adjacent to the coast, yet mining operations, no matter where they are undertaken, would have to include the transportation of the bulk of the ore from the tops of hills varying in elevation from 200 to 400 meters, down to sea-level. Water-power is available, but in undetermined quantity.

A recent investigation by the division of mines, Bureau of Science, on the island of Leyte, revealed the presence of a considerable deposit of rock-asphalt, which, so far as can be judged from the results of chemical examination, ought to be suitable for paving purposes. Good pavements are very expensive in the Philippines, and it is probable that the rock-asphalt will come into extensive use if it proves to be satisfactory. The presence of the mineral in Leyte had not hitherto been known, although numerous small deposits of solid bitumens had been found. It develops that many of these outcrops of pure, solid bitumens are of no commercial importance because of the limited quantities which they represent. Certain well-defined veins of a bitumen, which is probably to be classed as grahamite, are however, worthy of exploration. A bitumen-cemented breccia of clay-tuff has been found in a deposit which appears to be extensive enough to be important. This material contains about 25% of bitumen, and it is possible to recover about 70% of the total bitumen in the shape of heavy oils, kerosene, and (a little) gasoline, by fractional distillation. Petroleum is associated with the solid bitumens in Leyte and appears at the surface at three different places. The petroleum has a paraffin base, and yields a high proportion of burning oils. The rocks in the Leyte asphalt and petroleum region are Miocene and younger in age, and consist principally of shale, clay-tuff, and tuff-sandstone. The structure of the field is complex, and the sedimentary formations have been intruded at numerous places by small domes and sheets of andesite. In its general features, the Leyte field is closely related to the better-known petroleum regions in Tayabas and in Cebu. None of the fields have been exploited commercially.

The three boats of the Philippine Dredges, Ltd., continue to make good returns.

LONDON

Tough-Oakes Finances.

The company that was organized in London to operate the Tough-Oakes gold mine at Kirkland Lake, Ontario, has come to an inglorious end. A year and a half ago, a great splash was made on the Stock Exchange by the flotation of the Kirkland Lake Proprietary, a company promoted by H. G. Latilla to acquire interests in the Tough-Oakes and other mines in the district. Shortly after an English company was formed, called the Tough-Oakes Gold Mines, Limited, to acquire through the Kirkland Lake Proprietary 426,388 fully paid $5 shares in the Canadian company of the same name, together with options on 171,110 further shares. The consideration for the shares and options was £127,152 cash, and £246,250 in fully paid shares of the English company. The issue of shares in the English company on the London market provided the company with £200,000 in cash. Of the money thus received, £44,996 was paid to the Kirkland Lake Proprietary for 66,781 shares in the Canadian Tough-Oakes company, and also £30,253 for Kirkland Lake Proprietary shares. The latter shares were apparently bought from the Union and Rhodesian Trust, another of Mr. Latilla's companies, which acted as secretaries to the Kirkland Lake Proprietary and the English Tough-Oakes. After these payments a balance of £124,749 remained, of which presumably a large portion would be required for completing the purchase of the shares in the Canadian Tough-Oakes company. Most of the money, namely £112,831, was however advanced to directors and companies of the Latilla group, the security when such existed consisting of shares in these companies. What the actual value of these securities would have been had the War not happened is not clear; but no doubt the shares could have been negotiated in one way or another on the Stock Exchange and the loans liquidated. The War, however, upset all calculations. The money could not be recovered, and the shares became unsaleable. The English Tough-Oakes found itself in the awkward position of not being able to complete its contract to buy the Canadian Tough-Oakes shares. An action has been commenced in the Courts to enforce the contract, and a second action was brought petitioning for a compulsory winding-up of the English Tough-Oakes company. The hearing of the petition is postponed until the first action is completed. How the contract is to be enforced is not clear. It is a pity that so good a little mine, with which are associated as engineers men of repute, should become involved even distantly in this unpleasant financial tangle.

COBALT, ONTARIO

Coniagas, O'Brien, Kerr Lake.

In spite of the low price of silver there is a brisk demand for the purchase of silver prospects in the Cobalt district.

The Coniagas company is constructing an addition to its concentrating plant to recover silver lost in the slime. Twenty-four canvas-tables, laid on cement floors, having a total area of 4000 sq. ft., are to supplement the concentrators. It is expected that 3 to 6 tons of rich silver concentrates will be produced from the 70 to 80 tons of slime made from crushing 180 tons of ore. The canvas concentrate will be treated by cyanide in a small plant of 6-ton capacity.

The O'Brien Mining Co. has commenced work at its property in the Gillies Limit, and known as the A-1. It is situated on the ridge running south from the McKinley-Darragh, and adjoins the lot on which the Temiskaming and the Hudson Bay are working. A head-frame is almost completed, and a shaft will be sunk 200 ft. The ores contain silver and galena.

It is rumored that the Kerr Lake company is negotiating for purchase of control of the old Drummond mine, which at one time was the premier producer of the Kerr Lake section.

The Dome July output was 28,300 tons of $4.67 ore.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

The Alaskan Engineering Commission, which is to build the Government railroad from Seward 471 miles to Fairbanks, has received a permit from the Forest Service to cut 85,000,000 ft. of timber in the Chugach national forest for use in constructing the new line. The permit was issued by the District Forester at Portland, Oregon, who has direct supervision of the Alaskan forests, and is in conformity with the Act of March 4, last, which authorized the Secretary of Agriculture to permit the Alaskan Engineering Commission and the Navy Department to take from the national forests free of charge earth, stone, and timber for use in government works. The timber will be cut in designated areas along the right-of-way of the proposed railroad, which runs through the Chugach forest for several miles. Experiments and tests of Alaskan spruce and hemlock are being made at the Forest Service laboratory at Seattle, and so far have substantiated the opinion of foresters that Alaskan timber is sufficiently strong for practically all structural purposes. While these facts are going on Forest Service employees in Alaska are marking the timber to be cut along the proposed railroad, the cutting to be done so that only mature trees are taken, the young trees being left uninjured, and the condition of the forest improved. This cut of 85,000,000 ft. will be the largest amount of timber ever felled on the Alaskan forests at one time. At the average rate per 1000 board feet obtained for timber sold from the Chugach forest during the fiscal year 1914, it is worth approximately $145,000 on the stump. It will be nearly twice as much as the total quantity of national forest timber now cut and used annually for local purposes throughout Alaska, but only a little more than one-tenth of the estimated annual growth of the Alaskan forests. The two national forests of Alaska contain about 78,000,000,000 ft. of merchantable timber and it is estimated by the Forest Service that more than 800,000,000 ft. could be cut every year forever without lessening the forests' productivity.

The area of the Chugach national forest, which is to be crossed by the railroad that the Government is building from Seward to Fairbanks, is reduced nearly one-half by a proclamation, signed by President Wilson, returning approximately 5,802,000 acres to the public domain. This action follows classification of the land by the Forest Service showing that the areas involved are not of high enough timber-value to warrant Government protection, and means the largest elimination of national forest land ever made by a single presidential proclamation.

Juneau

The Alaska Mexican company reports that in June the 120-stamp mill crushed 14,254 tons of ore for gold worth $15,231. The cyanide-plant treated 365 tons of concentrate, yielding $10,805. Out of the total return of $26,036 the profit was $3527. Owing to the accident to the Central hoist the mill only worked 19 days 16 hours.

At the Alaska United 270 stamps crushed 43,209 tons for $39,092. Nine hundred and forty-one tons of concentrate yielded $36,324. The output was $75,406, and profit $9427.

ARIZONA

Cochise County

Churn-drilling costs at the Sacramento hill is the subject of a paper by Arthur Notman of Bisbee in Bulletin 104 of the A. I. M. E. This hill is a mass of granite-porphyry intruded along a fault between Paleozoic sediments and pre-Cambrian schists. The outcrop of the hill is elliptical and approximately 3000 ft. long and 1400 ft. wide. The Sacramento shaft, the main hoisting-shaft of the Copper Queen property, is situated at the east end of the hill. The Hollbrook shaft is at the west end. Prospecting the hill started from these points at 400 ft. This was continued to February 1913, when a good deal of 3.53% ore had been developed by 19,604 ft. of workings. Churn-drilling was then decided upon from the surface. No. 1 steam-driven churn-drill put down 28,770 ft. in 22 months at a cost of $1.402 per foot. The footage per 8-hr. shift was 16.7. No. 2 and 3 Armstrong electrically-driven churn-drills put down 37,064 ft. (average hole 427 ft.), at $2.385 per foot. No. 1 steam drill on Sacramento hill drilled 16,617 ft. at $1.115 per foot. No. 2 drill was in bad ground.

Mohave County

Good ore has been opened at 400 ft. in the Black Eagle workings of the Tom Reed company. Some time ago 40 ft. of low-grade ore was cut at 200 ft., and the superintendent, W. J. Dower, of these claims predicted that good ore would be found at 400 ft. The shoot is the southeast extension of the Tom Reed vein system. The ore is worth $20 per ton. The width has not been determined yet. A new shoot was found last week at 500 ft. in the Ollo Oatman portion of the Tom Reed.

Ten days' pumping has unwatered the Orion mine. Men are now cleaning out the workings. Los Angeles people control the property. It has produced a good deal of gold, but was closed several years ago.

The Tom Reed company has passed its monthly dividend and bought control of the Crown City property, north of the Tom Reed, for $200,000. Development has been under way for several years by the previous owners.

Little is heard of the Golconda mine, but it is sending 100 tons of 40% zinc ore to Bartlesville, Oklahoma, every day. Net returns are said to be 9c. per pound of zinc.

Pinal County

At 900 ft. in the Magma mine the vein was recently cut, the first 7 ft. assaying 17% copper, 13 oz. silver, and $3 gold per ton, and the next 5 ft., 3% copper, the other metals not being given. The face of the cross-cut is in mineralized formation containing some chalcopyrite.

CALIFORNIA

Amador County

The preliminary estimate of the Plymouth Consolidated's July run is as follows: ore treated, 11,000 tons; gold recovered, $55,000; operating expenses, $29,081; development charge $3919; net surplus, $22,000.

Calaveras County

It is proposed to increase the Calaveras mill's capacity to between 500 and 600 tons per day. Copper ore and concentrate continue to be dispatched regularly. Experimenting is giving good results.

Eldorado County

A deed has been recorded at Placerville showing that J. A. Britton, of San Francisco, has sold to L. C. Burpree, of Oaklank, several placer claims on the middle fork of the American river in this county for $30,000.

Nevada County

Grass Valley district mines are employing more men than ever before. The total is 1000, of whom 400 are employed by the North Star company (not including 250 at its Nevada City

property), 330 by the Empire, 110 by the Brunswick, 43 by the Golden Center, 30 by the Union Hill, and many others at the Black Bear, Osceola, Signal, Cassidy, and Kenosha mines. Foundries and other industries employ about 250 more. The city has now a population of approximately 6000 people. Orchards and farming help to add to the importance of the centre.

The Kenosha mine, four miles below Grass Valley, which has been closed for four years, is being unwatered. It will then be examined. G. F. Drake and San Francisco people have a bond option on the property.

PLUMAS COUNTY

A 100-ton flotation plant is to be installed at the Walker mine, 25 miles north of Portola, according to J. F. Cowan of Salt Lake City. F. E. Steffy will supervise its erection. Over 30 men are employed at the mine, in which a wide vein has been opened, some of it assaying 6% copper. An aerial tram 1.5 miles long will carry ore to the plant.

SAN BENITO COUNTY

The New Idria Quicksilver Co. is attracting attention on the Boston Stock Exchange, on account of large profits from the increase in price of mercury. The capital is $500,000, $5 par, now $12. In 1914 the dividend was 14c. per share. A profit of about $350,000 is expected this year, and $1.50 per share may be distributed.

SHASTA COUNTY

(Special Correspondence.)—The Mammoth Copper Co. is building a road to its Friday-Lowden mine to facilitate transport of supplies and ore. Surveys are being made for a tramway from the Stowell mine to connect with the ore-conveying system to the Kennett smelter. The tramway will be approximately two miles long. Developments are proceeding vigorously at the Stowell and Spread Eagle mines, with 35 men employed. Preparations are being made for extensive work at the recently-acquired Golinsky group. A large tonnage of ore is available for immediate extraction and early shipments to the smelter are planned.

The general manager, Frank M. Leland, of the Balaklala Copper Co. is to arrive at Coram about August 20 to take charge of operations. The trestle at the railroad end of the tramway has been re-built and other improvements made to the line. It is understood that ore shipments to custom smelters will be resumed pending the result of tests with the improved Cottrell process at the Coram plant. Re-building of the smelter stack will commence in the near future.

Developments are proceeding vigorously at the Dry Slide gold mine, near Keswick. Steady shipments to the Martinez smelter of the Mountain Copper Co. will commence soon. Fred McCarthy is manager.

The Sugar Loaf mine, near Copley, has been taken under option by L. G. Cliewe. An examination of the ore reserves is proceeding. The mine contains gold-bearing quartz, and has been worked intermittently. It is owned by F. M. Archer of Montgomery Creek, California, and Robert A. Martin, Portland, Ore. The purchase price is $10,000.

Frank S. Green, of Ono, has started preliminary work on the Bell Cow and Lost Calf claims, near Harrison Gulch.

The Green Horn Copper Co. is completing improvements at the mine which will enable the management to ship 15 to 20 tons of ore daily to the Kennett smelter. San Francisco people are largely interested.

The Gambrinus Mining Co. is driving a cross-cut from the lower level in hope of intersecting the main orebody. The mine is at Stella. H. F. Rogers is superintendent.

Redding, August 16.

At Heroult, the Noble Electric Steel Co. has two furnaces producing ferro-manganese, and one making ferro-chrome. The output is to be increased.

SIERRA COUNTY

Another rich pocket has been opened in the Tightner mine.

COLORADO

CHAFFEE COUNTY

In Bulletin 104 of the A. I. M. E. the Salida smelter of the Ohio & Colorado Smelting & Refining Co. is described by F. D. Weeks. The plant is at an altitude of 7000 ft., 215 miles southwest of Denver, on the D. & R. G. line. The Crested Butte coal and coke, and lime deposits at Monarch and Garfield are nearby. The plant contains six lead blast-furnaces, two copper-matting furnaces (not used), three Godfrey and one Wedge furnace, and four Dwight-Lloyd sintering-machines. The capacity of the whole is 500 tons per day, the chief lead supply coming from the Coeur d'Alene in Idaho. Ores with iron in excess are obtained from Leadville, and the silica supply is helped out by clinkered zinc-residue from plants of an allied company operating in Oklahoma. A longer abstract of this article, dealing with peculiar original construction at the plant, appears on page 282 of this issue.

LAKE COUNTY (LEADVILLE)

At the Penrose shaft of the Down Town scheme, the pumps will soon be working at full capacity again. There is still 405 ft. to be unwatered to the 875-ft. level.——The zinc-oxide plant is working full time. Most of the carbonate ore treated comes from the Robert E. Lee mine on Fryer hill.——Results at the St. Louis continue to be excellent. Some zinc ore has been opened, in addition to the rich gold shoot.——The Waterloo, on Carbonate hill, is shipping 150 tons of manganese daily. ——Lessees at the Forest City No. 2, at Big Evans, are developing a promising vein.——The Bwlchcogh mine, Twin Lakes district, is to send ore to the A. S. & R. smelter. The output will be 50 tons per day.——The Gordon-Tiger mill is being rapidly erected. As soon as the Robert Emmett owners can arrange for the sale of their zinc ore the output will be largely increased. Regular lots of 25-oz. silver and 21% lead ore is shipped.

MINERAL COUNTY

(Special Correspondence.)—There is very little doing at Creede, and the present price of silver is not conducive to new work.

The Creede United Mines Co. is operating the Humphreys mill on ore from the Happy Thought and adjacent properties, and is shipping about 325 tons of lead concentrate per month, also a small amount of zinc concentrate.——The Last Chance-Del Monte is shipping about 300 tons per month.——The Commodore is being worked in a small way by lessees who are shipping about 250 tons per month.——The Equity company is sinking from its adit. To continue development it expects to put in a small compressor and hoist driven by an oil-engine in the near future. Tests have shown that the ore is amenable to cyanidation. If the development continues favorable a mill will be erected.——The Denver & Rio Grande company has a corps of surveyors working on the proposed broad-gauge line to Durango. Everybody seems to think that the company is really going to build it in the near future. This line will start from the Creede branch at South Fork, and pass through Pagosa Springs. If it is built it will cause a considerable boom in the southwestern part of Colorado and in northwestern New Mexico. This line has been talked of for 15 or 20 years, and it is difficult to believe that it is really going to be built. If it is built, and if the Southern Pacific builds its proposed line from Lordsburg to its coalfields near Durango it will give a new and shorter route to Los Angeles.

Creede, August 14.

SAN JUAN COUNTY

Flotation processes are attracting considerable attention in this county, especially around Silverton. Good results are obtained at the King and Mears-Wilfley mills. A plant is in course of erection at the Hamlet mill, and arrangements are being made to add a plant to the Iowa-Tiger. At the Silver Lake mill the American Ore Flotation Co. is getting excellent returns.

IDAHO

Shoshone County (Coeur d'Alene)

Final figures of the output of the mines of this region in 1914 are now available, as filed with the county assessor. They are as follows:

	Tons.	Value.	Profit.
Caledonia	22,336	$ 560,958	$ 322,857
Gold Hunter	10,543	421,318	45,926*
Sierra Nevada	77,270	566,825	159,240
Bunker Hill & Sullivan	440,819	3,374,388	802,559
Hecla	123,857	925,869	196,137
Federal (Mullan)	202,400	1,257,192	99,122
Federal (Wardner)	219,200	942,108	72,943
Green Hill-Cleveland	190,965	2,324,961	1,046,757
Snowstorm	60,958	371,125	22,394*
Tamarack-Custer	20,685	957,359	182,256
Interstate-Callahan	88,664	828,961	187,063
Hercules	60,559	4,147,610	1,868,762
Success	82,664	232,520	23,946*
Ontario	88,857	712,667	239,175
Stewart	189,615	2,140,363	854,433
Yankee Boy (lease)	358	38,646	4,557
D. Blake (Yankee Boy royalty)	.....	.....	6,891
Total	1,899,750	$19,802,393	$6,042,752

*Loss.

Mining, etc., totaled $6,653,269; freight, $6,399,079; and repairs and improvements, $1,133,037.

The president of the Snowstorm Mining Co., Leo Greenough, recommends that the surplus of $172,762 be spent in purchasing two properties and developing new producing mines with the present equipment. In September last the Snowstorm orebody cut out and work was stopped. Fire last week destroyed the power-plant, compressor, boiler-house, etc., at the Rex (Sixteen-to-One) mine. Men from the Interstate-Callahan helped to fight the flames. The plant will be replaced, according to the manager, M. J. Sweeny.

New York, San Francisco, and Spokane people have acquired the Rex mine in the Nine-mile district, near the Tamarack & Custer, for $200,000. It has been shut down for about five years. The property is equipped with mining and milling plant. The lower workings are full of water, and three weeks will be required to drain them. Charles Sweeney is general manager.

At the National copper mine the electric-haulage system, from the mine to the mill storage-bins, is being installed. It is expected that the 500-ton mill will start early in September. The main shaft is 1200 ft. below the main adit.

MICHIGAN

Houghton County (The Copper Country)

The Calumet & Hecla is now mining up to 12,000 tons of ore daily.——The Winona company is experimenting with leaching.——The report of the Wolverine company shows the following in its financial year: ore stamped, 397,614 tons; mineral produced, 9,734,850 lb.; copper in mineral (74.48%), 7,250,866 lb.; revenue (12.81c. per pound), $929,193; total cost (8.43c. per pound), $610,991; profit, $318,202; dividends, $360,000; and surplus, $787,311. Ground opened at No. 35, 36, 37, and 38 levels of No. 4 shaft was generally satisfactory. Work at No. 3 shaft was also good. About 44.6% of the ore hoisted was broken by 'Jackhamers.'

MISSOURI

Jasper County

Prices of zinc-blende during the week ended July 7 varied between $75 and $100 per ton for 60% product. The output of the region was as follows: blende, 6404; calamine, 218; and lead, 1330 tons, averaging $86.64, $50, and $52.37 per ton, respectively. The total value was $635,380. Up to the above date, the Missouri-Kansas-Oklahoma region had produced $14,000,000, an increase of over $1,000,000 for this period of 1914.

The Granby company's drilling campaign at Chitwood has resulted in four holes cutting ore in disseminated formation at 130 to 180 ft., assaying about 5% blende and lead. This ore will be taken to the B. H. mill, a distance of 800 ft., for treatment.

MONTANA

Cascade County

After 2 years 8 months and 4 days' work, the Montana Power Co.'s dam at the Big Falls of the Missouri river was completed last week. Water is flowing over it. The structure is 1340 ft. long and contains 216,000 cu. yd. of concrete.

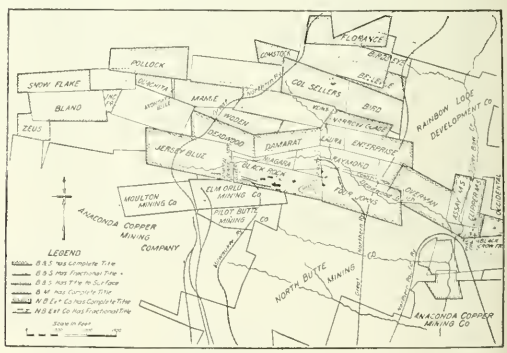
Fergus County

During July the North Moccasin mine of the Barnes-King Development Co. produced 3610 tons of ore yielding $28,000. An oil-fired revolving-roaster is being installed with other plant, costing $11,000. The Piegan-Gloster mine treated 1759 tons of $9.91 ore in July, with 84% recovery. High-grade concentrate was also produced. An electric hoist is working at the Gloster shaft, which is to be unwatered. The Norman adit is in 770 ft., in quartz worth $5 per ton. The dispute between the company and the Kendall has not been settled.

Silverbow County

Two men were killed at 2800 ft. in the Tramway mine by a premature blast last week. The cause is unknown.——The North Butte company is to increase its output to 2,500,000 lb. copper per month. The first half of 1915 yielded 7,800,000 lb., giving $425,000 net.

The Black Rock shaft of the Butte & Superior is down 1900 ft. in ore averaging 18.2% zinc.



BUTTE & SUPERIOR PROPERTY.

The second Montana state first-aid meet was held at Billings on July 23 and 24, under the auspices of the Montana Coal Operators Association, United Mine Workers of America District No. 27, Anaconda Copper Mining Co., U. S. Bureau of Mines, and the American Mine Safety Association. Prizes were awarded to the teams making the highest general average in all events. The winners were as follows, the contests being one-man, two-men, three-men, and full team event: First, silver contest medals and a silver loving-cup, team No. 5 of the Leonard mine, Butte; second, bronze contest medals and $75 cash, team No. 9 of West Colusa mine, Butte; third, $50 cash, team No. 10 of Washoe reduction works, Anaconda (this team was tied for third place by team No. 6 of Klein, but in working off the tie, team No. 10 won third place); fourth, $30 cash, team No. 6 of Klein; and, fifth, $20 cash, team No. 8 of Tracey. The special prize of a silver loving-cup

presented by the Montana Coal Operators Association, and held for the past year by the Red Lodge team, was won this year by team No. 10 of Anaconda for making the highest average in the team problems.

A mine had been built of 2 by 4 in. lumber and tar-paper, in which it was proposed to have an explosion and rescue of supposed victims. The explosion took place all right according to schedule, but on account of the heat of the sun, the flash of the black powder used in the explosion set fire to the heated tar-paper, and before the rescue crew could enter the tunnel the entire structure was in flames. The men who were to have acted as victims were obliged to escape through the sides of the mine before the rescue-crew arrived. So from the view-point of the rescue-crew, the demonstration was more or less of a failure, but from that of the audience it was a spectacular success.

NEVADA

Esmeralda County

The July return of the Jumbo Extension is estimated at 2900 tons of ore worth $101,500. Sampling, freight, and treatment cost $28,000; and mining, development, and general, $13,500; leaving $60,000 profit. The present output is at the same rate. Good results continue from exploration of the shale and contact veins. Above 945 ft. they are one, but split just below, at a fold fault. Rich ore is being opened at all points.

Humboldt County

The Darby mill at Seven Troughs has been overhauled, and is treating ore from the Delaware mine, which is developing well. The plant consists of 10 stamps and cyanide-plant of 100-ton capacity.

Fire on August 16 destroyed a large part of the town of upper Rochester.

Nye County

Tonopah mines last week produced 10,320 tons of ore valued at $211,720. Some July returns were as follows:

Mine.	Tons.	Yield.	Profit.
Belmont	14,020	$171,556	$72,459
Extension	7,754	.....	*40,340
Jim Butler	....	.....	30,751
Tonopah	12,390	160,935	77,165

*June.

At 1260 ft. in the Extension the vein has been opened for 450 ft. Stopes average 12 ft. in width.——At the Jim Butler a great deal of development is in progress.——In the West End a cross-cut has opened ore 200 ft. below any previous shoot found.——Lessees are doing well in several mines.

Storey County

The 2700-ft. level in the east branch of the Comstock has been opened for exploration, and the main Comstock lode in the north end workings has also been rendered available to within a few feet of the 2700-ft. level, the principal necessary air connections for the main Comstock in that region having been made individually by the Ophir, Mexican, Union, and Sierra Nevada companies. By means of the drainage system installed, the main Comstock lode above and below the 2500-ft. level in the north-end mines has been made accessible for exploration for the first time since 1884. Water being pumped from below 2700 ft. is less than anticipated. Drainage to 2900 ft. can be continued, and ore at that depth developed. This work is done under the auspices of the Comstock Pumping Association.

NEW MEXICO

Santa Fe County

The Santa Fe Gold & Copper Co. is attracting attention on the Boston Stock Exchange. The company is controlled by the Lewisohn's. It has 3400 acres of mineral area, and 46,000 acres of coal and other land 20 miles from the Atchison railway. Late in 1913 a blast-furnace started work. Production was suspended on account of the War, but resumed in May 1915. July profits were $26,000. Additional funds may be required for the erection of another 125-ton furnace. The total capacity would be 90,000 tons of ore per year, yielding 7,500,000 lb. copper. To treat the low-grade ore a flotation plant is being considered. Motor-trucks are used for carrying metals and supplies.

Socorro County

The Socorro Mining & Milling Co. has purchased, at a sale by order of the Court, the Mogollon Gold & Copper Co.'s property for $100,000. The estimated output is $1,250,000, of which only $22,500 was paid in dividends to 1906. The claims are in the Cooney district of the Mogollon mountains, 85 miles northeast of Silver City. Work is to be resumed at an early date.

OKLAHOMA

Okmulgee County

A smelter is being erected at the new town of Kusa, about five miles east of Henryetta, by G. E. Nicholson and others. There is plenty of natural gas available at low prices. Joplin zinc concentrate will find a good market at the new plant.

Ottawa County

The Empire District Electric Co., operating in the Joplin, Missouri district, will extend its transmission-lines 24 miles into the Miami area.

TEXAS

Culberson County

(Special Correspondence.)—Extensive development of the zinc mines of El Paso and Culberson counties, in western Texas, is promised as a result of a recent visit to this part by a party of Missouri zinc-mining men. It has been known for several years that large deposits of zinc ore existed in this part of the state. Considerable development has been carried on from time to time on one of the larger mines in El Paso county. The mining men who are now arranging to take hold of the properties with the view of placing them on a large producing basis are J. D. Cameron, Charles Hart, and A. D. Corbin, all of Joplin, Missouri. Mr. Hart took samples from the different properties.

Advise has been received here of the discovery of rich bismuth ore in an old mine on the Texas-New Mexico line, north of Van Horn. The prospector who located it is Joseph Taylor. A preliminary shipment has just been made to New York, and it is stated that plans for development of the mine will depend largely on the returns that are received from this shipment.

An unusual amount of mining activity is reported to be now in progress in the Allamore district, situated northeast of Van Horn. Four separate camps have been established there and many gold claims are being prospected. J. I. Johnson reports that he already has a considerable quantity of high-grade ore on the dump. The outfitting and supply point for the district is Toyah, Texas, on the Texas & Pacific railroad.

T. B. Everheart, who recently leased the Enterprise mine, situated near Van Horn, from T. R. Owen, has begun developing the property on a large scale. He is making regular shipments of copper ore to the smelter at El Paso.

Recent shipments of copper ore from the Pecos mine, near here, to the smelter at El Paso, brought returns of $14 to $28 net per ton.

Van Horn, August 10.

UTAH

Salt Lake County

The Utah-Apex Mining Co. will pay 12½c. per share, equal to $63,000, on October 1. This is the initial quarterly dividend. The cash on hand amounts to $200,000. The output is at the rate of over 30,000,000 lb. of lead per year. Costs will be reduced by the flotation plant being erected.

Summit County

Shipments from Park City during July were as follows: Silver King Coalition, 4440; Daly-Judge, 2268; Silver King Consolidated, 1725; Daly West, 983; Ontario, 983; E. J. Beggs, 47; Big Four Exploration, 104; G. A. Keeps, 36; and Daly company, 70 tons, a total of 10,051 tons.

The Snake Creek tunnel is now in granite, and the daily progress is about 16 ft. No timber is necessary. The flow of water is 7650 gal. per minute. A power-plant is to be erected to be driven by this water.

WASHINGTON

Spokane County

It is estimated by Charles T. Underwood, secretary of the Spokane Stock Exchange, that sales by the 20 brokers who are members aggregated not less than $1,500,000 in July. It is thought that this record will be beaten in August, as the activity among investors has increased greatly in the last 10 days. Trading is principally in Coeur d'Alene companies.

Stevens County

The Silver Trail Mining Co. has been organized by Spokane people to develop the old Clugstone mine, eight miles east of Evans in the Colville district. A. O. Smith is in charge. A lower adit is in 700 ft., partly on a vein.

CANADA

British Columbia

The Nelson district is unusually busy, in spite of a lack of money for new development. Spokane people are being interested in the Alpine property, 12 miles up the Kootenai river from Nelson. According to A. Larson, about $12,000 has been spent in preliminary work on the low-grade free-milling gold ore. Three adits have been driven. About $500,000 is required to bring the mine to the producing stage.

Sixteen miles from Anyox are the four claims of S. J. Eubank and D. F. Jones. A wide lode runs through them, cut at intervals by dikes. The ore assays from 0.01% copper and 40c. gold to 2.7% copper and $1.60 gold per ton. A drill has put down a hole 85 ft., of which 64 ft. averaged 4.2% copper and good value in gold. A fair equipment has been installed. Under certain conditions the owners are willing to sell a quarter interest in the property.

Ontario

During July the Nipissing high-grade mill treated only 37 tons of ore; the low-grade plant treated 6960 tons. The output was $179,998 from the mine. Two machine-drills are working on surface veins uncovered by the hydraulic plant. One assays 3000 oz. over two inches. No. 150 shaft has been closed, as results were not favorable. No. 80 was re-opened.

The Genessee Mining Co., composed of Rochester, New York, people, is to re-open the old United States Cobalt mine, north of the Chambers-Ferland. The 60-ft. shaft is to be sunk to the contact, about 400 ft. deeper. Work was stopped in 1906.

On September 1 the Dome company will pay a quarterly dividend of 5%.——A syndicate of McIntyre shareholders has purchased control of the Pearl Lake mine. The same people are said to be negotiating for the Jupiter.——Diamond-drilling will probably be started at the Preston East Dome shortly.——The West Dome may be organized as the West Dome Consolidated, and work resumed.

Molybdenite is being mined and shipped from a property near Renfrew.

Lumbermen at North Cobalt, who use Mill creek and Cross lake for floating logs to their mill have filed application for damages against the companies that discharge their mill residue into these waters. The lumbermen claim that the tailing damages their logs, also the standing timber. Mr. Haultain, professor at the University of Toronto, has acted as arbitrator in the dispute, and his report is now in the hands of those concerned.

PERSONAL

James W. Neill is in town.

Harley E. Hooper is in Burma.

D. M. Riordan is in New Mexico.

Henry E. Wood, of Denver, is here.

C. B. Lakenan has been in New York.

Hennen Jennings is at the Clift hotel.

H. P. Henderson, of New York, is here.

William Roberts is in Eastern Siberia.

A. C. Ludlum is expected from New York.

Baron Alfred De Ropp is here from New York.

T. P. Sharman has returned to London from Colombia.

Allen H. Rogers has returned to New York from Burma.

F. M. Ayer is manager for the Wild Goose Co., at Nome, Alaska.

S. K. Bradford has arrived from Mazatlan and is now at his home at Palo Alto.

W. B. Blyth has resigned from the staff of Bewick, Moreing & Co. to go to Rhodesia.

H. C. Dudley passed through San Francisco on his way from Oregon to Wyoming.

A. Charles Meagher, recently with H. Kenyon Burch at Miami, is in San Francisco.

Robert T. Hill passed through San Francisco on his return from New York to Los Angeles.

Philip Wiseman passed through San Francisco on his way from St. Paul to Los Angeles.

Howland Bancroft sailed from New Orleans on August 11 by the *Turrialba* on his way to Bolivia.

A. C. Brinker, manager of the Buena Tierra mine, in Chihuahua, is taking a holiday in California.

David Cole is to become a resident of El Paso; he is visiting Cananea, and will shortly proceed to Anaconda.

G. D. Delprat, of the Broken Hill Proprietary, is now also manager of the Broken Hill Associated Smelters.

C. H. Munro, who has returned from Colombia, has moved his office to the Hobart building, San Francisco.

A. L. Blomfield, superintendent of the Golden Cycle mill, Cripple Creek, has been a visitor to the Exposition.

W. W. Breen has accepted an appointment as mill foreman with the Shan Tsz Gold Mines Co., in Eldorado county.

William Thum, superintendent of the electrolytic lead refinery at East Chicago, is visiting the western properties of the United States Smelting, Refining, & Mining Company.

The Industrial Accident Commission of California announces that public hearings are to be held to consider the proposed general safety orders for State industries. The first will be at the Underwood building, San Francisco, on August 25, and the second at the Union League building, Los Angeles, on September 3. Employers, employees, and others are represented. Unless good reasons for changes are submitted at the public hearings, the proposed orders will subsequently be made permanent by the Commission. Copies of the tentative general safety orders will be supplied on request from the offices of the Industrial Accident Commission, 525 Market street, San Francisco, or Second and Hill streets, Los Angeles.

Volume VIII of the Transactions of the American Institute of Metals is to hand. With five Bulletins of 56 pages, the publication covers 450 pages. Abstracts will be made in later issues of the Press.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, August 19.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	4.75— 5.70
Quicksilver (per flask)	$90
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, August 19.—There are no buyers for copper; the lead market is dull; zinc is falling steadily with no buyers.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Aug. 12	17.25	July 7	19.75
" 13	17.00	" 14	19.50
" 14	17.00	" 21	19.04
" 15 Sunday		" 28	18.62
" 16	16.85	Aug. 4	18.27
" 17	16.75	" 11	17.94
" 18	16 50	" 18	16.89

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the last week of July totaled 12,026,139 lb., valued at $2,265,251. Italy received 4,399,329; England, 2,408,582; Russia, 2,017,216; France, 1,477,017; Norway, 1,078,014; and Holland, 381,651 lb. Imports totaled 3,052,279 lb., worth $346,580. Peru sent 1,748,006 and Canada 1,005,216 pounds.

July outputs were as follows: Braden, 2,890,000; Greene-Cananea, 3,000,000; and Old Dominion, 3,199,000 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug. 12	48.25	July 7	48.10
" 13	47.87	" 14	47.56
" 14	47.37	" 21	47.47
" 15 Sunday		" 28	47.29
" 16	47.00	Aug. 4	47.08
" 17	46.75	" 11	47.27
" 18	46 75	" 18	47.33

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57 58	48.85	July	54.90	47 52
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec	49.27	....

A large drop in silver was the feature of the week. The rise early in the week was probably due to the San Francisco Mint buying a total of 1,175,000 oz. Of this, 250,000 oz. was purchased from the A. S. & R. Co. at 48.887c., and a similar quantity at 49c. There is a big demand for silver coins.

Normal shipments of metal from the United States to London are 1,250,000 oz. per week; they are now only about 250,000 oz. Cobalt shipped 321,018 oz. in the week ended August 14. The Nipissing refinery produced 550,121 oz. in July. Exports of silver from London to the Orient this year, to the end of July are about 16,000,000 oz. less than in this period of 1914. Rain has been light in the Punjaub district of India, this affecting Indian buying of silver. The monsoon has been irregular.

The U. S. S. R. & M. Co.'s mines in Mexico are at 50% of capacity. A rich development is reported.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July 21	95.00	Aug. 4	95.00
" 28	95.00	" 11	95.00
		" 18	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38 60	90.00	Dec.	53.10	....

The London price is £18 (86.40) per flask. The Nevada Cinnabar Co. at Ione is producing 8 to 10 flasks daily. The New Idria is making large profits.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Aug. 12	4.45	July 7	5.75
" 13	4.40	" 14	5.71
" 14	4.40	" 21	5.58
" 15 Sunday		" 28	5.50
" 16	4.45	Aug. 4	5.12
" 17	4.50	" 11	4.79
" 18	4.45	" 18	4.44

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Aug. 12	13 50	July 7	22.10
" 13	12.50	" 14	22.26
" 14	12.25	" 21	20.33
" 15 Sunday		" 28	18.96
" 16	12.25	Aug. 4	17.79
" 17	11.75	" 11	15.12
" 18	11.00	" 18	12.21

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4 45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The U. S. Geological Survey estimates the domestic production of spelter for the first half of 1915 at 207,634 tons, against 177,991 tons in that period of 1914. Adding foreign ore treated here, and secondary metal, the total is 242,000 tons. Apparent consumption was 160,906 tons, an increase of 11,244 tons. Stocks at smelters are 5884 tons

In its second quarter the Butte & Superior company produced 37,780,020 lb. of spelter. The profit was $2,197,153, an increase of $933,996.

The Interstate-Callahan made a profit of $1,126,114 in the second quarter. Joplin concentrate declined $15 per ton last week, prices being from $60 to $85. The U. S. S. R. & M. Co. is buying 25% ore from Utah mines.

TIN

Prices in New York, in cents per pound

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39 76	37.23	Aug	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48 25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40 96	Dec.	33.60	....

Tin is dull at 33.75 to 34.75 cents. Australian producers are sounding the New York market with a view to sending their tin. The Australian tin is of high grade, two brands superior to Straits.

ANTIMONY

The market has been dull. As in the other metals there is a lack of new business, and pressure to sell Chinese and Japanese has caused prices to decline. The quotations August 12 were 33.50 to 34c., duty paid. Antimony mines on Pine creek, Idaho, are being actively worked.

Eastern Metal Market

New York, August 13.

Except for very brief spurts of activity on the part of electrolytic copper and tin, all of the metals have been continuously dull. In copper the market was established at 18c. for a short time, then demand became sluggish again, and nominal prices declined until 17c. was quoted August 13. The London market much resembles that in New York, in that there is weakness on every side. The chief hope for copper is a renewal of exports, which lately have not made a good showing, and in the development of needs on the part of the munition manufacturers in this country. Zinc has continued to decline, although prompt deliveries are not easy to obtain in large quantities, some of the producers being sold up. On the other hand, dealers are willing to let go of metal they bought at the recent high prices. They have been waiting for the market to turn upward, as it will with any considerable show of interest on the part of consumers. The principal lead interest has reduced its quotations repeatedly, and independent sellers have not only followed but have given concessions. Lead which was bought at a high price has been sold at a substantial loss. Tin saw a flurry of activity when the price became attractive at 34.62½c. Antimony also lacks new business and quotations are weak. Aluminum is firm and in the best position of any of the metals.

In iron and steel, the feature of the past week has been the purchasing of large quantities of steel-making pig-iron at advances of $1 to $1.25 per ton, a natural sequence of the heavy demand on the steel mills in recent weeks. Foundry irons still lag behind, though they, too, show some betterment. Both speculators and founders have tried to buy iron for delivery in early 1916, but without success. The jobbing foundry trade is picking up, but this line is not enjoying anywhere near the prosperity of the steel-makers. In July the unfilled orders of the Steel Corporation increased 250,000 tons, which was 163,000 tons under the increase of June, but shipments in July were much heavier. Additional capacity which was started lessened the unfilled orders. The production of pig-iron in the United States in the first half of 1915 was 12,233,-791 gross tons, against 12,536,094 tons in the same period of 1914. Exports of iron and steel in June totaled 355,829 gross tons, against 143,953 tons in June 1914. Those of the fiscal year ended June 1915, totaled 2,003,798, against 2,076,364 in the same period of 1914. In June 1915, the exports of metal-working machinery totaled $3,735,562, as compared with $1,079,810 for June 1914. Those of the fiscal year just closed amounted to $28,162,968, against $14,011,359 last year. In the ten months ended April 30, the exports of brass sheets totaled 13,100 tons, against 2050 tons in the same period of 1914.

COPPER

Late last week, when electrolytic came down to 18c., a few thousand pounds was bought, but the movement soon came to an end, and it did little more than demonstrate the true level of the market as it existed at that time. Since then the dullness has been as pronounced as it was before the flurry. Prime Lake was sold to a limited degree at 20c., and a carload or two is said to have been sold under 20c. It is evident that unless conditions change the quotations for Lake and electrolytic will be on a par again. Despite falling prices, it is generally agreed that copper has a basis which is fundamentally strong. The ordinary domestic consumption is not good, although improving. The War consumption shows no decrease, and there is every likelihood of an increase when the great war contracts for munitions are further advanced. In many cases large plants, especially those newly constructed, are not yet in readiness for manufacturing. A great many conjectures are heard as to the cause of the present lull in the market, which at the present time is so quiet that prices are only nominal at best. From 17.87½c. cash, New York, August 9, electrolytic has declined to 17c., the quotation on August 13. Experienced traders point out that heavy buying cannot be maintained at all times, and that some of the consumers who bought heavily on the rise of the market are comfortably supplied until September, at least. The London market has been dull and weak. The exports August 1 to 14 totaled only 8128 tons. English interests recently have made shipments of copper for refining in the United States. Reports as to Germany's supply vary all the way from a statement that she has plenty of the metal, to a cable that the German government has ordered the conservation of all copper cooking utensils. The fact is that nobody knows except the Germans themselves.

ZINC

Both London and New York have been dull with quotations steadily declining. Between August 2 and 11, the London market dropped over £27. It stood at £65 August 11, against £100 a few days ago. The New York quotation for prime Western on the same day was 14.25c. On August 13 it was 12.75c. Strangely enough, though quotations have dropped so steadily prompt metal is not easy to secure, and the entire tendency is simply a manifestation of the severity with which consumers are letting the market alone. Dealers are offering more freely. Brass mill spelter is proportionately lower at from 18 to 23c. Sheet zinc was quoted August 11 at 21c., f.o.b. smelter, a figure entirely out of alignment with the present quotations for spelter. Substitutes for sheet zinc are still being sought. There has been a good demand for sheet zinc for ammunition boxes. Exports to August 14 totaled 2414 tons.

LEAD

In a dull market the quotations for lead have pursued a downward course. The A. S. & R. Co. reduced its New York price August 7 from 5.25 to 5c.; on the 9th to 4.75c., and on the 10th to 4.50c. Following all of the recent reductions of the leading interest, independent sellers, both dealers and consumers have offered the metal at concessions. On August 4 when the big interest was asking 5.25c., two or three carloads were sold at 4.75c., but the general asking price at that time was 5c. With the A. S. & R. Co. quoting 4.50c., outsiders ask 4.45c. Deliveries of lead which was purchased in the frenzied rise of a few weeks ago, are still being made at a heavy rate, and some of this metal is being re-sold at losses. The situation is one where buyers sent the market up on themselves and now are bringing it down, to their cost. New York and London prices are nearing a parity. There is no question but that the large producers are anxious of resuming exportations inasmuch as foreign sales are needed to absorb American production. But little American lead has been offered in London of late, while Australian metal has been sold in considerable quantities. London on August 10 was down to £21 17s. 6d., equal to 4.53c. c.i.f., London. The exports to August 14 totaled 791 tons.

TIN

A week ago it was intimated that the price of tin was getting to a point where it must become attractive to consumers regardless of their being well supplied, and the situation culminated in a good buying movement on August 3. Between 500 and 600 tons changed hands on that day, with the sales mostly in far distant futures, with a sprinkling of spot and nearby deliveries. The buying started when the price touched 34.62½c. The new York quotation for spot, August 13, was 34.50c. The London market is extremely dull and uncertain. There has been some good buying at the Straits, partly on account of the Steel Corporation, and the price at Singapore August 12 was £6 10s. higher than the London market.

BOOK REVIEWS

Purchasing. By C. S. Rindfoos. P. 165. Index. McGraw-Hill Book Co., New York, 1915. For sale by Mining and Scientific Press. Price $2.

The purchase of mine supplies is very important. On the price paid often depends the quality, and subsequent effect on operating costs. The knowledge of how to buy, and at the lowest price, is not learned in a day. Terms are often desired in purchasing, and favorable terms are important. Quick delivery is usually necessary for mine stores. A purchaser should possess a personality as well as knowledge of his business. All of these points, and others, including departmental organization, and forms of purchase are discussed in this book on a subject of which little has been written.

Chemical German. An introduction to the study of German chemical literature. Second edition. By Francis C. Phillips. P. 252. Index. The Chemical Publishing Co., Easton, Pennsylvania. For sale by the Mining and Scientific Press. Price $2.

A number of noted German chemists have contributed to this work. It includes rules of nomenclature, exercises for practice, vocabulary of German chemical terms (54 pages) and others used in German technical literature. Readers of Classical German often find difficulty in mastering German scientific terms, many dictionaries not giving correct meanings of the terms. Many chemicals are made only in Germany, and an understanding of them is necessary. The book under review should prove of value to many chemists in America.

Determinative Mineralogy. By J. Volney Lewis. Second Edition. P. 155. Ill., index. John Wiley & Sons, Inc., New York, 1915. For sale by Mining and Scientific Press, San Francisco. Price, $1.50.

This book is written to be used in connection with some treatise on descriptive mineralogy. The determinative tables are well arranged; the re-statement of tests that accompany each page are especially convenient. Novel reactions are given for copper, nickel, tin, and tungsten; that for cassiterite with hydrochloric acid and zinc is well adapted for use by prospectors. The book could be made much more useful to students by giving type minerals to illustrate the various lusters, structures, bead tests, and other physical and chemical qualities. Ozokerite, amber, wurzilite and a few other hydrocarbons might well have been included. An unfortunate omission is the failure to give a detailed account of the use of the tables through the determination of several illustrative minerals. The cursory laboratory record given on page 64 is woefully inadequate. The index is scanty, a few minutes examination shows the absence of luster, streak, specific gravity. A short bibliography of a few of the many books that have been written on determinative mineralogy should have been included.

RECENT PUBLICATIONS

Products and By-Products of Coal. By Edgar Stansfield and F. E. Carter. P. 51. Charts, Department of Mines, Ottawa, 1915.

Year Book of the United States Department of Agriculture, 1914. P. 715. Ill., index. Washington, D. C., 1915. A number of interesting papers, with 53 plates and 45 text figures combine to make a valuable volume on a basic industry which employs over 50% of the population, and produced crops and animals worth $9,872,936,000 in 1914.

Report on Mining Operations in Quebec in 1914. P. 151. Index, Department of Mines, etc. Quebec, 1915. The value last year was $11,732,783, a decrease.

Abstract from Annual Report of the Department of Mines of Kentucky for 1914. By C. J. Norwood and assistant inspectors. P. 40. Lexington, Kentucky.

An Investigation of Iowa Fire Clays. By Milton F. Beecher. Bulletin 40. Engineering Experiment Station of Iowa State College of Agriculture and Mechanic Arts. P. 117. Illustrated. Ames, Iowa.

The Coking of Coal at Low Temperatures, with Special Reference to the Properties and Composition of the Products. By S. W. Parr and H. L. Olin. Bulletin 79. P. 39. Illustrated. University of Illinois Engineering Experiment Station, Urbana, 1915.

State of Connecticut State Geological and Natural History Survey, Hartford, 1915:

Central Connecticut in the Geologic Past. By Joseph Barrell. Bulletin 23. P. 44. Illustrated.

Triassic Life of the Connecticut Valley. By Richard Swann Lull. Bulletin 24. P. 285. Ill., maps, index.

U. S. Bureau of Mines, Washington, D. C., 1915:

Production of Explosives in the United States in 1914. Also notes on coal-mine accidents due to explosives. Compiled by Albert A. Fay. Technical Paper 107. P. 16.

Occurrence of Explosive Gases in Coal Mines. By N. H. Darton. Bulletin 72. P. 248. Ill., maps, plans, index.

Building and Ornamental Stones of Australia. By R. T. Baker. P. 169. Ill., map. Published by authority of the Government of New South Wales, Government Printer, Sydney, 1915. Australia contains many deposits of granite, marble, limestone, basalt, and other rocks suitable for building, and this excellent work shows sections of them in colors, and many buildings erected. The lithographic work is the best we have seen.

U. S. Geological Survey, Washington, D. C., 1915:

Production of Chromic Iron Ore in 1914. By J. S. Diller. P. 15.

Production of Slate in 1914. By A. T. Coons. P. 14.

Production of Mica in 1914. By Douglas B. Sterrett. P. 11.

Recovery of Secondary Metals in 1914. By J. P. Dunlop. P. 9.

Production of Mineral Paints in 1914. By James M. Hill. P. 20.

Sulphur, Pyrite, and Sulphuric Acid in 1914. By W. C. Phalen. P. 19.

Production of Fluorspar in 1914. With a note on cryolite. By Ernest F. Burchard. P. 7.

Silver, Copper, Lead, and Zinc in the Central States in 1914. Mines report. By B. S. Butler and J. P. Dunlop. P. 98.

Ground Water in Paradise Valley, Arizona. By O. E. Meinzer and A. J. Ellis. Water-supply Paper 375-B. P. 75. Ill., chart.

Geology and Mineral Resources of Kenai Peninsula, Alaska. By G. C. Martin. B. L. Johnson, and U. S. Grant. Bulletin 587. P. 243. Ill., maps, plans, index.

Guidebook of the Western United States. Part A. The Northern Pacific Route, with a side trip to Yellowstone Park. By Marius R. Campbell and others. Bulletin 611. P. 212. Ill., maps, index. Price, $1 from the Superintendent of Documents. The first of this series was reviewed in the Press of July 17.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Westinghouse Exhibit at the Exposition

A large and attractive exhibit has been arranged in the Palace of Transportation at the Panama-Pacific Exposition by the Westinghouse Electric & Mfg. Co., of East Pittsburg, Pa. It includes one of the Pennsylvania railroad electric locomotives mounted on a turn-table under the centre of the dome of the building at the junction of the two main aisles, thus bringing it in full view of visitors. The turntable is 65 ft. long, and weighs 440,000 lb., including the locomotive. The height of the track is 12 ft. above the floor. Steel ties are used, a new type of construction for this class of work. The foundation was described in the March issue of *Western Engineering*. By means of 10-hp., 3-phase, 220-volt motor, the turn-table revolves once in three minutes. The direction of rotation can be reversed. An unusual method of collecting the current for lighting the locomotive is employed. This was designed by the Westinghouse engineers and involves bringing the leads

WESTINGHOUSE ELECTRIC LOCOMOTIVE.

up through the centre bearing to collector rings, thus obviating the use of third-rail shoes or trolleys. The locomotive is arranged and lighted so as to permit the people to pass through it and inspect the equipment. This locomotive is said to be the largest in the world in passenger service. It consists of two units and weighs 156 tons, and is the first side-rod gearless locomotive ever placed in service. It is equipped with two motors having a total capacity of 4000 hp., and Westinghouse unit switch-control equipment of the HBF type which has made the great record of 99.549 miles per train minute. Statistics show that twelve million passengers are transported annually over the electrified terminal of the Pennsylvania railroad from Harrison, New Jersey, to Pennsylvania station, New York, by these locomotives, which are capable of attaining a speed of 60 miles per hour with full train.

In addition to the locomotive, the newly developed types PK and HL control for railway motors are shown in operation. These control equipments will operate motor-racks equipped with 40-hp. motors. The PK control operating head can be applied to any standard type K controller.

A complete line of commutating-pole railway motors, including box, and split frame types for various voltages from 600 to 1500 are also shown, and in addition a preliminary sample of the new pressed steel railway-motor.

In the Palace of Machinery the firm has an extensive exhibit. It includes the following: domestic motors, fans, and heaters; lamps and fixtures; transformers and motors open for inspection; single-phase motors; variable-speed alternating motors; induction motors; motors with forged-steel frame; back-geared induction motors for low driving speed, with rawhide pinion and steel spur wheel, now used largely in driving stamp-mills, etc.; enclosed direct-current motors; semi-enclosed direct-current motors; direct-current reversing motors for tool machines; vertical direct-current motors; direct-current elevator motors with semi-magnetic elevator controller; direct-current commutating-pole mill motors for the severest service; rheostats; Westinghouse Sirocco blower; Westinghouse Le Blanc low-level jet-condenser; and a Westinghouse-Parsons steam turbine (open for inspection) reaction type blading and impulse wheel direct-connected to a 652-kva. generator and 15-kw. direct-current exciter.

Commercial Paragraphs

In Bulletin No. 130, the CHICAGO PNEUMATIC TOOL CO., discusses the importance of lubrication of pneumatic tools.

At a meeting of the directors of the AMERICAN LOCOMOTIVE CO., New York, held on August 11, J. O. Hobby, Jr., was appointed treasurer of the company.

Catalogue H-2 of 64 pages, published by the LEA-COURTENAY CO., Newark, New Jersey, describes the various types and sizes of centrifugal pumps manufactured by the firm. The design of some of the pumps is interesting.

In Bulletin No. 1093 the ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, describes its engine type direct-current generators. Pictures show the parts of the machines. Several large engines are driven by gas engines. A variable-speed motor driving an A.-C. mine hoist is shown.

Electric steel and electric furnaces will be shown at the Foundry and Machine Exhibit at Atlantic City, September 25 to October 1, when an electric furnace of the SNYDER ELECTRIC FURNACE CO., Chicago, will be in commercial operation, melting cold scrap and pouring three times each day. Tests will be made of the castings.

On and after August 10, the PACIFIC TANK & PIPE CO., of Portland, Oregon, will be known as the National Tank & Pipe Co., (incorporated in the State of Oregon.) The personnel of the new corporation remains the same, namely, Wm. E. Hampton, F. M. Kirsch, H. P. Sackett, Walter Carnes, B. C. Seydel, H. D. Coale, L. E. Long, and J. W. Willis. They have made the name Pacific Tank & Pipe Co. synonymous with quality for the past quarter of a century and will still direct the policy and business of the new company, and their endeavor will be to make the National Tank & Pipe Co. occupy the same high plane.

The MORSE BROS. MACHINERY & SUPPLY CO., Denver, Colorado, has opened a machinery exchange department. On account of the many changes in treatment, machinery is often displaced by other because it is not suitable to the problem in hand. This machinery at another mine or mill may be just what is needed. Mines are requested to send the firm lists of anything available, with the price asked, and it will be listed and advertised without expense. Those wishing machinery should state their requirements, as it is possible that at some mine near to them is the plant they are looking for. A considerable saving is often made in freight as well as in the purchase price. This department will handle goods that on account of distance cannot be purchased and shipped to Denver.

EDITORIAL

T. A. RICKARD - Editor

NAMES are often queer misfits, in persons and in things. Thus the Butte & Superior Copper Company produces no copper, while it is a generous producer of zinc. This fact will make some indexes look foolish in years to come, if not now. We note that the old tailing-heaps of the Butte & Superior are to be reworked. Many pre-flotation dumps will prove mines of metal, by aid of flotation.

CANANEA is on a silver basis; Nacozani and El Tigre are to follow suit. The mining companies operating in these three localities purpose making their pay-roll payments in silver currency, much to the satisfaction of their Mexican workmen. Paper money in Mexico is a thing of ridicule just now, hence the silver peso is in the ascendant. Steps to restore order in Mexico will have to include some wise adjustment of the money problem. Cananea gives the hint.

SLACKENING of purchases of metals, in anticipation of lower prices, has depressed quotations for copper, zinc, and lead, as is shown by our New York correspondent's report. This weekly summary of the metal market will be found interesting and reliable by all those engaged in producing and selling metals. We give consumers' prices, not those of the metal-brokers and selling-agencies. It is probable that a recovery will be manifest shortly, for enormous orders for munitions have been placed in this country and these will require big tonnages of the base metals.

SUGGESTIONS that a mining engineer must express an opinion on the origin of the ore in a mine upon which he reports appear occasionally, as in a recent article in *The Mining Journal*. While some intelligent notion of the genesis of the ore deposit may aid the engineer in his estimate of the probabilities of further ore being found in the mine, it is extremely dangerous for a man to allow any theory to prejudice his observation of the facts. When interstellar ether and solar energy are brought into an article on the subject of mine appraisal, we venture to protest against the absurdity.

ZINC, according to the Geological Survey's semi-annual statistical report, has been produced to the amount of 242,000 tons during the first half of the current year, compared with about 190,000 tons in the previous six months. Thus the rate of production was 484,000 per annum, but the rate for the current six months is increasing by reason of new retorts coming into operation. At the end of June 127,000 retorts were in use, while 32,000 more have been completed since then, representing an increase already of 25%. Thus our earlier estimate of production at the rate of 550,000 to 600,000 tons of zinc by the end of 1915 is confirmed.

THE Federal Government of Australia has taken steps to create an Australian Metal Exchange under its own control. No metals or metallic products will be allowed to leave the country unless they are sold in Australia under precise rules and regulations. None but registered members of the Metal Exchange will be allowed to buy, and no persons will be registered unless the Government is satisfied that the applicants are pro-British and that their applications are in good faith. The Amalgamated Zinc Company was allowed to send 50,000 tons of zinc concentrate to the Edgar Zinc Company, at St. Louis. The price of sale was given as $46 per ton delivered at Mobile, Alabama.

THE RANKIN-WESTLING system of ore treatment will soon be tried on a large scale at the $250,000 plant of the Nevada-Douglas Consolidated Copper Co., which is expected to start about the first of October. This process consists in the treatment of unroasted copper-sulphide ore with dilute nitric acid and, if necessary, some sulphuric acid, in a digester under a 10 to 20-lb. pressure per square inch, at a temperature of 100° C. Air is blown through the digester at the rate of 110 to 135 cubic feet per minute. The process dissolves the copper, which will be precipitated by scrap-iron or electrolytically. As there has been much discussion as to the practicability of this process, its operation at the Nevada-Douglas plant will be watched with interest.

MEXICAN affairs progress but slowly. Carranza's generals and governors have echoed his pious belief that the government of the First Chief of the Constitutionalist party is above reproach and is quite capable of restoring order in Mexico. Villa, Zapata, and their henchmen are willing to be good and to agree to a general conference. Five independent governors also are amenable to Mr. Wilson's proposal, as supported by the South American governments. Border affrays continue to furnish sensational headlines in the evening papers on days when no large vessel is torpedoed. We await the development of events. Meanwhile the warring factions represent about 2% of the 15,000,000 people in Mexico and of these belligerent persons not more than a fifth are actually fighting. Yet, on their account, the rest of the country is exposed to the pestilence of the unburied dead, to the encroachment of

famine and of a lawlessness without hope. Apparently Carranza is the chief obstacle to a settlement. He is probably a sincere reformer, but narrow-minded, pompous, and intensely jealous of foreigners. Moreover he appears to lack the instinct of leadership, namely, the ability to inspire loyalty in his lieutenants. On the whole, the First Chief is an awkward customer, and nothing much can be done until he is either placated or eliminated. How strong he is cannot be ascertained by listening either to him or to Villa. The Administration at Washington ought to be fully aware of this, for it has sent various representatives from time to time on excursions of enquiry. Mr. Wilson must be well informed, whatever he may have lacked in knowledge of Mexican affairs when he first tackled the thorny problem. Patience is a virtue hard to practise, and if peaceful coercion succeeds the President will have done a great thing. But time is not unlimited. The Mexican tangle must be unraveled before the European war ends, and as much sooner as possible.

PROTESTS are being made in Peru against the export tax on mineral products. Of the total exports 47% comes under this category. It is claimed that mining more than any other industry is civilizing the Indian and is educating the natives generally. In the mining districts a notable improvement in methods of living is apparent. Influx of foreign capital has contributed to the welfare of the country and stimulated private enterprise. Not only would an export tax be an unprovoked hardship on the mineral industry, but even the threat of it is injurious to established business. It is urged therefore that the suggestion be killed and that an explicit assurance be given that the industry will be immune from such an embargo for at least 20 years.

TO Mr. E. P. Mathewson and the Anaconda Copper Company we are indebted for a short, but most timely and interesting, article on the operation of the flotation plant in the Washoe works. The kerosene-sludge mentioned is, we presume, the residuum obtained in the refining of oil. It contains as much as 50% sulphuric acid and is a by-product of little value to the oil companies themselves but of immediate usefulness to the flotation metallurgist. A copper-mining company in California asked recently for a price on this oil-acid residuum and was offered it at 16 cents per gallon by one oil company, but later obtained a quotation of $4.50 per ton from another oil company. The use of wood-creosote reminds us that Carnegie tar, the by-product from coke manufacture, is suitable in flotation, when thinned by a lighter oil. The adoption of Hardinge mills is significant, for it may be assumed that the choice is the result of careful tests. So is the expressed intention to employ steel balls and a manganese-steel lining in the tube-mills. That is in accord with the experience at Inspiration, where it has been proved that steel balls are more effective than pebbles, yielding a better product and saving power. The Callow cells for cleaning are a feature of American flotation practice, and we are giving away no secret when we state that this type of apparatus was invented independently and previously by Mr. T. J. Hoover when he was with the Minerals Separation company. At the time it was not deemed worth while to patent the design. Subsequently Mr. J. M. Callow hit upon the idea without any knowledge of the facts just recorded. The method of adding the reagents in the Washoe flotation plant is unique, as Mr. Mathewson says. We direct attention to his description of the revolving discs whereby the feed is regulated. The use of the Oliver filter for draining the flotation concentrate is an adaptation from cyanide practice. Any difficulty in the treatment of the concentrate itself is avoided by passing it to the reverberatory furnace. Apparently the old water-concentration mill at Anaconda is being replaced in sections without any serious interference with regular operations. We hope to give further details at an early date.

Concentration of Copper Ore by Flotation

Most of our readers are aware that the extraction of copper by the usual method of gravity concentration, however elaborated, has averaged not more than 70%. Such a result is a metallurgical failure, even if the incompleteness of the recovery be hidden by the cheapness of the process when applied on a big scale to immense bodies of low-grade copper ore. In short, it represents the temporary waste of a natural resource, to the detriment chiefly of the present owners of the mines rather than to the loss of the community as a whole, for the discarded residue may be re-treated profitably at a later date, as is being done at Anaconda. There a high recovery is being made from 2000 tons of tailing daily. While the surface of such discarded residues may be so oxidized as to allow of the copper being dissolved and removed by rain-water, it appears that this natural leaching effect is superficial, so that it does not penetrate the mass of a dump, unless we grant a period of time measurable geologically. In the effort to improve the extraction, the eye of the metallurgist or millman has been focussed upon the saving of copper in the slime, the needlessly fine product produced in the attempt to grind the ore to a degree sufficient for the separation of the metallic particles from the associated gangue. This expectation was doomed to repeated disappointment because the sliming of the copper sulphide, chiefly chalcocite, put a large proportion of it in a condition definitely beyond the reach of gravity methods of concentration. Thus the tendency in current practice turned to the avoidance of sliming, so that the main desideratum became the liberation of the metallic particles in a granular form. This, of course, led to careful crushing in stages, and multiple-stage concentration, assisted by an elaborate system of screen-sizing and so-called hydraulic classification, all of which entailed a high cost of construction per unit of capacity but large dividends from the low-grade deposits uncovered during recent years.

Indeed, it was believed that the art of dressing copper ores, especially those of the disseminated chalcocite type, had begun to crystallize into its final form and some learned authorities sought to record the 'laws' governing these operations and to standardize rules for the achievement of their purpose. But the 30% loss compelled furious thinking and checked over-confidence among the more seriously minded. In his perplexity the metallurgist turned to leaching methods and for a while we began to think, with Disraeli, that sulphuric acid was the ultimate measure of industrial prosperity. Several new processes, and more old ones in new guise, had just caught public attention when flotation, long obscured in the fog of patent litigation on the other side of the Atlantic, came into prominence. It was not the old bulk-oil process, nor the surface-tension method, but flotation by froth. Success was immediate, as applied to copper ores, in Montana and Arizona, for example. The newest process had the important advantage of being able to select and recover the copper in the slime that had been beyond the reach of water concentration. In fact, that part of the metal-contents in sulphide form that had been farthest from the reach of gravity methods was found to be the product most easily within the grasp of the frothing treatment. This departure immediately made possible great simplicity of plant and machinery in the treatment of such ores as were amenable to the process. Moreover, since firing with coal-dust has made reverberatory smelting more economical than blast-furnace practice, the various stages in crushing and concentrating can be greatly reduced and simplified. Reverberatory furnaces require a fine feed and yet do not entail loss by dusting, thanks to electric precipitation of that ancient nuisance, so that with the aid of flotation there is no longer any hazard in the sliming of the sulphides that are amenable to the process, either through excessive loss in mill-tailing or by escape in roaster-dust. In short, the making of slime is now safe and sane. Among factors contributing to this epochal result, namely, the simplifying of concentration plants, is the introduction of the Butchart form of riffle, a modification of the Wilfley, and the recent recognition of the superiority of the tube-mills and ball-mills over rolls or stamps in preparing ore for concentration. Another discovery concerns the advantageous use of steel balls instead of flint pebbles in tube-mills. In cases in which the ore has a ratio of concentration, say, between 3 : 1 and 10 : 1, it may prove necessary to use three stages in separating the mineral, but when the ratio of concentration is higher, as at the disseminated copper mines, the stages of concentration may be reduced to two, not counting that done in the closed circuit. It is now possible, as suggested by Mr. David Cole in the February bulletin of the American Institute, to take run-of-mine ore, (1) pass it through a primary crusher, (2) run the product into a ball-mill of large capacity running wet and reducing to $\frac{1}{4}$ inch, (3) pass this product, without classification or screening of any kind, to Butchart riffles, (4) the tailing from which goes to re-grinding machines, such as pebble or ball mills, (5) the product of these being sent direct to a frothing machine, which is also a classifier, the first spigots removing the coarse material from the frothing machine across a table riffled *à la* Butchart and returning it to the grinding machine. This establishes a closed circuit in which the undersizes removed from the closed circuit are controlled by the operator of the frothing apparatus to the point yielding the most economic result. All the material that passes out of the closed circuit has been exposed to thorough frothing, and therefore carries none of the very fine slimed copper sulphide that formerly was lost. Everything not fine enough is retained in the closed circuit, so that only the slime and fine sand, the former free from sulphides, are able to escape. Thus the classification by frothing becomes the crucial part of the whole system of treatment, and the development of this form of flotation machine becomes an important step in the new metallurgy of copper.

Shares of No Par Value

In order to develop a mining 'prospect' it is necessary to raise capital. The most convenient method of getting this capital is by forming a stock company and selling its shares. Local mining men are usually the first buyers of such shares and when buying them know perfectly well that they risk losing their money. Hundreds, if not thousands, of such companies have been formed within the last few years and their shares sold to such open-eyed buyers. This perfectly above-board legitimate mining business sets the wheels of mining industry spinning and often results in developing mines that pay taxes, dividends, wages to workmen, salaries to engineers, and furnish a market for supplies and machinery, besides producing the metals needed by a material civilization. The incorporation of a mining company, such as is required for financing a 'prospect,' is a simple matter; the total expense of the incorporation in many of the Western states need not exceed $100; this sum will cover the State fee for incorporation, the cost of a seal, a sheaf of stock-certificates, and an account-book for the secretary. No lawyer is needed for these small companies. In consequence, in the boom days companies were formed on small, or no, provocation and their name was legion. Although there was no difficulty in forming a company, yet before any shares could be sold a serious difficulty had to be overcome. The trouble was that the shares could not be sold unless the company owned property the value of which was equal to its capitalization. For example: take the case where the property cost only $5000, while the company, as is usual in the West, had a capital of $1,000,000 in 1,000,000 shares, each with a par value of $1. Before any shares could be sold, the secretary, or some other official of the company, had to certify that the property was worth $1,000,000. This certification of a fictitious value was a stumbling-block to a conscientious secretary, but his worry was relieved by reflecting that the performance was a mere matter of form and that 'everybody's doing it.' Such perfunctory certifications were required in Nevada in 1907 and in other States, and it was prob-

ably to avoid a similar condition that the Railway Commission of California recently suggested that mining shares should have no par value. Remembering that the last California legislature passed 770 new laws, it is too much to expect that anyone can be sure of the present legal requirements.

The issuance of mining shares without par value has been often advocated by mining engineers, but the Kennecott Copper Corporation seems to be the first important company to have been formed on this basis. The shares of that company are now selling for $34 on the New York Curb. The only novelty about these 'no-value' shares is their adoption by a modern mining company. Cornish mines have been run for several hundred years on the cost-book system, in which the 'adventurers' paid losses or divided profits according to the results of the mining operations during monthly periods. No shares were used. Similar methods have been employed in other industries, notably by whalers, in which all worked for a share of the profits, the so-called 'lay,' which might vary from the captain's quarter to the 1 180th part for the greenhorn before the mast.

This idea of not fixing the par value is sound because at best the price of the shares as named at the start of a mining enterprise represents only a nominal valuation of the mine itself. Indeed, the share-valuation of a mining company bears only an indirect relation to the appraisement of the mine. The quotation for shares depends upon the excess of buyers over sellers, or the reverse; it may represent a sum much above or far below the actual wealth realizable from the ore in the mine. Therefore it would be well to express the assured profit by one kind of capitalization and the possibilities of further profit by another kind of capitalization. For example, we understand that Mr. A. C. Beatty suggested to Mr. Daniel Guggenheim that the assured profit in the Yukon Gold alluvial properties should be capitalized in the form of bonds, while the probabilities and possibilities of future development should be expressed by an issue of shares of no par value. If that had been done the Yukon Gold would have issued bonds for an amount equal to the profit to be won from the known gold resources of the property as ascertained by the examination made by Messrs. Beatty and O. B. Perry, and the 'water' would have been kept clearly separate by an issue of shares the value of which would be left to the vagaries of speculation as affected by future production, seasonal vicissitudes, and the temper of the public. The idea, we think, was good, except as to the designation of the first security. As mining—even the extraction of ore 'proved,' 'assured,' or 'in sight'—is necessarily subject to risk, it is well to recognize this basic fact by using an appropriate form of security. Bonds and debentures have a gilt-edged connotation that is misleading. Preferred shares would be better. These would represent the minimum of risk, for they would have a first call on the profits and a corresponding limitation of earning power, to be fixed at a given percentage (say, 8%) on the par value; while the ordinary shares, without par value, would be so much 'water,' representing the potentialities of the enterprise, and having therefore a bigger risk and the chance of a commensurate gain, both unlimited. The preferred shares would be a speculation so sound as sometimes to be rated as an investment, while the ordinary shares would range from a risky speculation to a wild gamble. As these things are now conducted, the assured and the probable, the possible and the impossible, are so mingled in the share valuation of a mine that the conservative speculator, who calls himself an investor, has little chance to do business on sensible lines. Under such a system a young prospect would be capitalized for shares of no par value, indicating that it had no liquid assets but large expectations, while a property with proved resources would issue preferred stock equivalent to its assured profit and shares of no par value to express the 'water' that by skill, luck, and the bounty of Nature may be turned into golden wine.

An Old Issue

Miners in California will shed no tears over the passing of the Anti-Debris Association, which became defunct on August 18, in consequence of the Sutter Basin controversy. This Association, to prevent hydraulic mining of gold-bearing gravel in the foothills, was supported by contributions from the counties in the Sacramento and San Joaquin valleys. Its moving spirit was Mr. Robert T. Devlin, who, in the proper exercise of his professional function, prepared the injunction suits that irritated the diggers in the Sierras. As a corrective, the California Miners Association was formed, but it also has died a natural death, largely because the hydraulic mining companies left the machinery manufacturers to support it. Messrs. Charles G. Yale and W. C. Ralston, and the late Jacob H. Neff, did yeoman service for the Miners Association and at one time its meetings served to rally the leaders of the mining industry in this State. For obvious reasons we regret that it should have been allowed to expire. Another organization to be mentioned in this connection is the United States Debris Commission, which stood between the two parties in the old warfare waged by the valley-farmers and the gravel-miners. It was organized to exercise control over the discharge and impounding of the tailing from the hydraulic mines. While Colonel W. H. Heuer was in command the Debris Commission was considered fair and reasonable, but of late, since he retired, the Commission has made many drastic rulings, insisting on solid concrete dams and not more than 3% of the silt to go over. This has discouraged the building of dams and put a stop to new hydraulic mining enterprises. The new Government commissioners have slight understanding of, and little sympathy with, the mining industry. On the whole, therefore, it is clear that the State is suffering from both lack of public spirit and interference with reasonable initiative. To those familiar with the alluvial deposits of the Sacramento and San Joaquin watersheds, it seems a waste of natural resources that they should not be exploited, to the gain of many and to the injury of none.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Speculation in Mining

The Editor:

Sir—It appears to me a most important duty of the technical publications and of the mining engineers to endeavor to arrive at a clear understanding of the reasons for the palpable lack of interest of the majority of the general public in mining enterprises.

That all mining enterprises are not a success is no adequate reason; failures occur just as well in all other classes of investment. True, the general public has practically no knowledge of mining, but neither has it a technical knowledge of the various industrial or commercial enterprises to which it confides its capital.

The greatest difficulty under which the mining industry labors is that the general public regards it as a purely speculative enterprise. We mining men may proclaim as much as we please that mining is a legitimate business enterprise, the general outside public refuses to believe it. This is especially remarkable in California, where such a number of financially profitable mining enterprises are carried out, and have been operated for a number of years. The general public apparently never hears of them, and takes no interest in them. "Mining is only speculation," it asserts. Once in a while the fever of speculation seizes the general public, and then it goes at it wildly, with the natural result of many disasters and only a few exceptional successes.

The only remedy I can see is a campaign of education, which will give the public a general comprehension of the bases on which the mining industry rests. This industry covers three entirely different phases: prospecting, developing, and operating mines.

The prospecting for mines involves a great amount of personal hardship; it requires practical knowledge, and the more technical knowledge the better, but, above all, tenacity of purpose and indomitable faith in final success. The prospector is an essential factor in the mining industry, and every action taken to curtail his activity is a great detriment to that industry. This phase, however, requires a small outlay of money and, therefore, comes only slightly in contact with the general public. A prospect only represents the fact that there are surface indications of a possible underlying orebody. Whether these indications are of sufficient importance to justify the outlay of money to ascertain the existence of such an orebody is one of the most difficult problems put to a mining engineer. The data at hand in nearly all cases are far from sufficient to enable him to decide this question; general experience, general knowledge, and local knowledge of the vicinity are the principal guides at his disposal.

The prospect now enters into the stage of development. This stage of the industry demands a serious outlay of money, and as it is to a certain degree hazardous, it is also entitled to large profits, which it invariably receives in case of success, provided the operations be conducted in a business-like manner. The development of prospects into producing mines, although not demanding such large outlays of money as are required to develop and operate big mining enterprises, yet demands such an amount of capital that generally it can be provided only by co-operation. It is imperative for the success of such development enterprises that they be placed in the hands of competent men; experience teaches that the great majority of failures in such enterprises can be traced to the fact that those who provide the capital fail to realize this fundamental principle. In general, work is started with a relatively small force, and to the layman it seems unnecessary to have a high-priced man in charge; a competent mine-foreman or a young graduate from a mining school, whose services can be had at relatively low figure, appear to him fully competent to superintend the small force, because he cannot comprehend that the direction of the work will, in most cases, determine the success or the failure of the undertaking, and that properly to direct those works technical knowledge and practical experience are absolutely necessary.

No mining engineer will claim that he is infallible, in fact, every mining engineer realizes that during the course of his career he has made mistakes, just as any man who has accomplished anything during his lifetime is conscious of having made mistakes. It is only the critic, who has never personally accomplished anything, who is infallible. In this respect the general public is unjust to the mining engineers, any mistake made by them is always brought forward, while their efficient work scarcely receives any public mention; moreover, many mistakes made against their advice are placed at their doors.

Experience teaches that not every prospect, upon development, will answer the requirements of a producing mine. It is therefore not a businesslike proposition to base the financial outcome of a mining enterprise, in the development stage, on the result of the exploration of one property. In such undertakings the principle of divided risk is the only method of safe finance. This requires a larger investment of capital than if only one

property is handled, but the chance of failure is reduced, and the speculative element is, in some degree, eliminated. Such an undertaking will require financial co-operation; but the resulting corporation can be organized on a much sounder financial basis.

Here is a field of action for mining engineers that will not only be profitable to them, but will place the profession in closer touch with the public, and engender a feeling of confidence between the two. Let mining engineers come into such corporations; if not financially able to participate, let them bring their services as an asset. Let the public feel that the interests of their technical co-partners are entirely the same as the interests of those who have put their money in the enterprise; then an atmosphere of confidence in mining enterprises will be created, and the public will realize that to be successful it must rely upon the co-operation of technical men, just as in all other commercial and industrial enterprises.

Another question must be taken into account: To obtain financial co-operation the public must be reached. This is a special line of business. Promotion has a bad reputation, and unfortunately not without cause, as many promoters have misled the public. Still, in nearly all cases, the participation of the public requires the co-operation of these intermediaries. These have for so many years considered mining enterprises as wild speculations, that it will take a campaign of education to get them in a frame of mind to consider mining as a serious business proposition. Mining enterprises based on a sale of stock at 5, or even 25, cents on the dollar are not attractive investments, they require a heavy over-capitalization, and are only acceptable as speculative ventures. The general public must be educated to the fact that mining investments, when properly made, are even safer than commercial investments; this must be pounded into the investing public not only through the medium of technical mining publications, but also through publications that have a more general circulation. It ought to be done by capable financial writers, who at present command on this subject a greater confidence of the general public than the mining engineers, because the public persists in considering the latter as prejudiced. The fact that Bradstreet's and Dun's commercial agencies in their reports show that the percentage of failures in legitimate mining investments is smaller than that in commercial investments, appears as a conclusive argument upon which to start such a campaign of education. This education requires the assistance of writers along those lines, because they alone know how to reach the public. It is a well-known fact that not all financial news reaches the public in such a form as to give it full knowledge.

Summarizing: the education of the public to an understanding of the intrinsic value of legitimate mining enterprises requires a long and persistent campaign, in which the co-operation of technical and financial authorities, with the distribution of facts through the medium of newspapers and magazines, as well as through technical papers, is required.

William Forstner.

San Francisco, July 31.

Professors of Mining

The Editor:

Sir—Relative to the recent letters on professors of mining, allow me to say that some professors whose main asset is long years of "practical experience" with nose-close-to-the-grindstone, have about as much value as informers on the conditions and peculiar problems of what they were working at, as the average soldier straight from the trenches knows about the war as a whole. This soldier usually says he found the trenches muddy or enjoyed the soup, then he "heard a big noise and woke up to hear the nurse say 'try a little of this'." Being too close to a subject may have an effect like looking at a big wall-map from a distance of two inches; a proper perspective is lacking.

P. B. McDonald.

Boston, July 30.

Concentrate: Then and Now

The Editor:

Sir—I read with interest Mr. Ebenstein's article in your issue of August 7, in which he compares the saving made by concentration in some of the older mills with that made by the modern, more up-to-date, plants. As I understand his article, he maintains that jigs, if rightly handled, would result in a better saving of the 'values' and would eliminate the necessity for tables and the treatment of the finer material by flotation.

While I am a strong supporter of the jig, under certain conditions, I have been under the impression that the jig, like every other machine, has its own place in the scheme of concentration and that one may encounter many conditions in which the jig would be out of place. In this connection I would like to ask what saving could be made on an ore averaging 2% copper where a large proportion of the mineral-bearing particles are not freed until crushed to 60-mesh or finer? This example is an actual case of ore now being treated in one of the large mills of the Southwest, the flow-sheet being approximately as follows: native copper removed by jigs at from half-inch to 5-mesh; the undersize from screening system passing over roughing-tables and the rough concentrate cleaned by Wilfleys; the tailing from roughing-tables and Wilfleys are classified, sand coarser than 40-mesh re-ground, the sand treated on vanners and the slime by flotation. Does Mr. Ebenstein contend that jigs alone would successfully handle this ore with a saving of better than 70%?

T. H. Oxnam, Jr.

Globe, August 21.

The treadwell club of employees of the Alaska Treadwell mine has 1500 members, each of whom pays $1 per month. The 12 directors are selected from employees and management. The club has large halls, a complete theatre, a band of 27 pieces, orchestra of 10 pieces, swimming tank, library, billiard tables, bowling alleys, reading and writing-rooms, moving picture shows, gymnasium, and athletic paraphernalia.

Scientific Management, The Utility of Rest Intervals

By W. H. SHOCKLEY

In my daily rounds through the mine I often stood watching Harry Trevethick as with loose swings of his hammer he drilled his holes. Thirty or forty blows of the four-pound hammer before his 'pass' was ended, then a cleaning out of the hole with the scraper, a little shifting of the position and another pass—a graceful rhythmic exercise, broken by frequent rests. He was supposed to work for about four hours, then blast his holes before lunch and to continue the same routine after lunch until the 10-hour shift was worn out.

Actually, however, no such steady work was done and a portion of the shift-boss's duty was to see that the miners did work steadily. Once in going through the mine I found a dozen miners stretched out at full length loafing in a big stope. My Welsh foreman, to whom I reported the incident, seemed more annoyed at my having gone through the stopes "like a monkey" than at the idleness of the men. He had hardly command enough of English to explain his views; perhaps if I had understood him fully I should not have thought it necessary to discharge several of the men for the sake of discipline. My foreman held that in spite of their loafing the men did a good shift's work. As far as I could learn, by comparison with the work done in other mines near us, we had a good class of miners and did as much or more work for the same cost.

Though theoretically a miner was supposed to work as constantly as possible during his shift, yet everybody knew that actually a good deal of time was devoted to resting; during the dozen years or so that I was an active mine manager many men were discharged for being caught while idle. A question that naturally arises from a consideration of the above circumstances is: Can a miner do more work by toiling uninterruptedly, or by taking short rests? Or, as the miners express it: Cannot a man do better work by 'tapering off' at intervals? I have often wondered if the men that I caught lying down in the stope did not do a good shift's work after all. I know of no investigations among miners that cast any light on this problem. Doubtless such investigations have been made, but I have seen no published results.

There is no question but that in many varieties of strenuous human effort the man who sets the steady pace —"the long, low gallop that will tire, the hound's deep hate, the hunter's ire"—will beat the man who makes his most violent effort and then rests. For instance: a man who ran his first hundred yards in ten seconds, then rested, then ran another hundred yards, and so on for a mile would be badly beaten by an experienced mile-runner who set a steady gait from the start. But whether the miner who worked hard and then rested would do more than the steady, though less strenuous, worker is an unsolved problem as far as my knowledge extends.

Taylor, the father of Scientific Management, relates an incident that casts a good deal of light on this subject. He and his fellow-investigators had worked out theoretically that a man engaged in hard manual labor could do more work if such labor was broken by rests so that the laborer is not over-tired. For their experiment they selected "Schmidt," a worker in the yards of the Bethlehem Steel Co. engaged in carrying 12½ tons of pig-iron per day and loading it on a car; the task was to get Schmidt to handle three or four times as much and make him glad to do it. This was done as follows: Schmidt was called out from among the gang of pig-iron handlers and talked to somewhat in this way:

"Schmidt, are you a high-priced man?"

"Vell, I don't know vat you mean."

"Oh, come now, you answer my questions. What I want to find out is whether you are a high-priced man or one of those cheap fellows here. What I want to find out is whether you want to earn $1.85 a day or whether you are satisfied with $1.15, just the same as all those cheap fellows are getting."

"Did I vant $1.85 a day? Vas dot a high-priced man? Vell, yes, I vas a high-priced man."

The rest of the conversation is too long to quote, but in the end Schmidt agreed to pick up a pig and walk, or sit down and rest whenever he was told to do so by a man with a stop-watch.

In his first day's work, under the control of the stop-watch, Schmidt, who had previously handled 12½ tons of pig-iron, loaded 47½ tons, or nearly four times as much, on his car. He had worked 42% of the time and rested 58%.

This was an astonishing result and already has had far-reaching consequences. Certainly, any ordinary superintendent coming on the scene of work and seeing Schmidt carry pigs for five minutes and then sit down and rest for seven minutes would have been very apt to say to his foreman "Fire that man; he's no good! Why he loafs more than half the time." And the said superintendent would find considerable difficulty in believing his own eyes when he saw that the man who worked a little and loafed a good deal was doing four times the work of the steady workers. It is as well to state that this work of Schmidt was not a spurt but was his daily task for a number of years, and the increased work had no bad physical or mental effect on him.

The explanation of Schmidt's ability to load four times as much pig-iron when working with rests as when working steadily is that he did not work long enough

at any one time to get fatigued. This question of fatigue is being ardently studied by psychologists all over the world and is a question of vital importance to Scientific Management. Avoidance of fatigue, however, does not account entirely for Schmidt's ability to load the 47½ tons of pig-iron, for on applying the same system to a gang of 75 men it was found that only one man in eight was physically capable of handling this quantity. But there was no trouble in finding plenty of other men to perform the same task.

While the fundamental laws of Scientific Management are easy to grasp—the basal law, indeed being nothing more than the doing of the most work, with the least labor in the shortest time—the practical application of the laws is an affair of great complexity. To establish the system in any particular business requires much experience and unlimited time. Taylor himself says that the proper way of introducing the system is by beginning with one man at a time and not by trying to influence a number of men at first, for many failures have been made by managers who have tried to introduce the system in a wholesale manner. In the PRESS of August 7 a request was made for information regarding the application of Scientific Management to mining work and it is hoped that this request may elicit some interesting facts.

Although it is likely that most readers of the PRESS are fully conversant with the literature of Scientific Management it seems worth noting that a bibliography of several hundred titles will be found in 'Scientific Management,' edited by Clarence Bertrand Thompson, Cambridge, Harvard University Press, 1914. The best single book on the subject is 'Principles and Methods of Scientific Management,' F. W. Taylor, New York, Harper Brothers, 1911.

Flotation at Mt. Morgan, Queensland

During the six months ended May 30, 1915, the concentrating plant at Mt. Morgan was practically remodeled under the supervision of C. Faul, of the Minerals Separation company. When completed it is expected to treat between 700 and 800 tons per day. The following is the record of the plant for the period:

		Assays.		Recovery.	
		Copper,	Gold,	Copper,	Gold,
	Tons.	%	dwt.	%	%
Ore treated	57,974	2.14	4.92	....	....
Table concentrate	12,696	2.89	10.06	29.60	44.78
Flotation concentrate	4,271	17.17	22.00	59.21	32.92
Total concentrates	16,967	6.48	13.07	88.81	77.70

All products contained 1100 tons of copper and 11,084 oz. gold. Concentration, briquetting, and sintering cost $1.67 per ton of ore treated.

PLATINUM PRODUCTION of the United States in 1914 was 570 oz. This was saved from placer mines in Oregon and California. The Boss mine, Nevada, yielded 110 oz. Russia produced 250,000 oz., Columbia, South America, 15,000 oz., and New South Wales, 1275 ounces.

Sampling Base Bullion

By F. D. WEEKS

*Originally the lead bullion was sampled by taking a dip-sample from the lead-well, which was not satisfactory. The present management built drossing-kettles in which the bullion is stirred by compressed air, skimmed into a Howard press, stirred by hand and siphoned out into bars for shipment, after sampling by dipping 'gum-drops,' approximately ½ A.T. in weight. For some time the results were unsatisfactory. Although the copper had been reduced to 0.06%, the bullion had a dirty appearance, and gum-drops of the same dip would not check with each other, especially as to gold content. Consultation with men versed in the subject did not help. A remedy was finally found when the temperatures were determined by a pyrometer and the difficulties overcome by the following procedure: Take off heavy dross at 900° F., blow until temperature reaches 680° F., skimming from time to time; raise the heat to 720° F. for sampling, and mold at 800° F. Since this method was adopted, little trouble has been encountered.

A plan to eliminate the personal equation in bullion assaying has been carried out for some years, with good results. The gum-drops, weighing about ½ A.T. each, are weighed without trimming, cupelled, and parted; the weights of the gum-drops in decimals of an assay ton, of the gold and silver together and of the gold alone, in milligrams, are reported by the assayer. The calculations are then made in the office on a machine. In this way the assayer is not tempted to make his results check, because until they are figured he does not know whether they will check or not. The excellent results obtained are sufficient reason for following the plan.

Metals Through the Canal

During the fiscal year ended June 30, 1915, the Panama Canal was open for traffic for 10½ months. In that time, 1088 vessels of 5,416,787 gross and 3,843,035 net tons measurement, passed through, carrying a total of 4,969,792 tons of cargo. Metals, ores, etc., carried were as follows, in tons:

Commodity.	Atlantic to Pacific.	Pacific to Atlantic.
Nitrates	411	651,537
Coal	279,064	7,500
Petroleum, refined	220,229	32,199
Iron and steel manufactures	196,234	5,968
Iron ore	2,200	83,904
Railroad material	56,106	.....
Copper	2,810	46,989
Machinery	32,788	954
Oil, crude	3,731	26,863
Tin [probably tin-plate.—EDITOR]	24,286	6,304
Cement	22,637	.....
Iron	21,198	.....
Copper ore	.....	20,740
Coke	20,444	.....
Chemicals	10,302	1,909

*Excerpt from a paper 'The Salida Smelter,' to be presented at the September (San Francisco) meeting of the A. I. M. E.

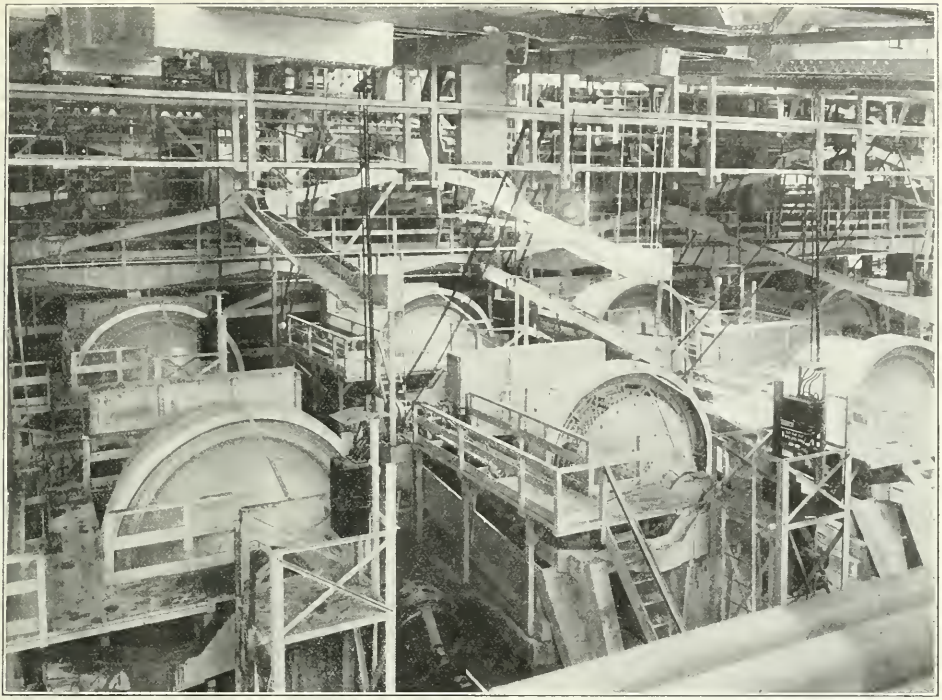


FIG. 1. GENERAL VIEW OF HARDINGE MILLS AND DORR CLASSIFIERS.

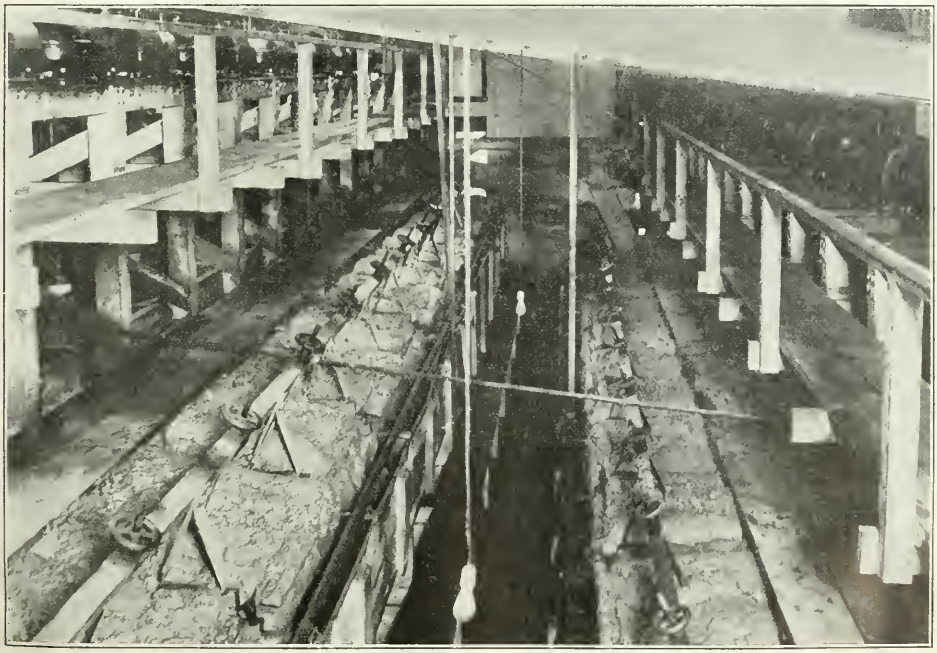


FIG. 2. MINERALS SEPARATION FROTHING MACHINES.

Flotation at Washoe Reduction Works, Anaconda

By E. P. MATHEWSON*

The mineral that is two millimetres and under in size is sent to the Hardinge mills for re-grinding. These mills are 10 ft. long by 4 ft. diam., and are in closed circuit with simplex Dorr classifiers, one classifier to each mill, 6 mills to the section, and 8 sections in the establishment. (See Fig. 1.)

The overflow from the classifiers goes to the flotation division, and the classifier-sand is returned to the Hardinge mills. At present pebbles are being used in the Hardinge mills, but, in all probability, steel balls will ultimately be used. With pebbles the Forbes lining is used, but with steel balls in use, each mill will be fitted with a false wooden lining to reduce the diameter of the cylinder, and a manganese-steel lining will be placed inside of this.

Each mill has a direct-connected 225-hp. motor. The mill fitted with pebbles requires from 95 to 115 hp., but the motors are made extra heavy, in anticipation of the use of steel balls.

In each section of the flotation plant there are four Minerals Separation machines, each having 15 agitators and 14 floating-compartments. Below these are six Callow cells for cleaning the concentrate. The agitators for the Minerals Separation machines are made of gun-metal and are driven by bevel-gears from the main shaft. (See Fig. 2.) Each machine is driven independently by a 150-hp. motor, running at 385 r.p.m. on full load. The speed of the agitators is reduced to about 225 r.p.m.

The product from the machines is a tailing, which goes to waste (from this tailing, fire-brick, building-brick, and acid-proof brick will be made in a new brick-plant now under construction); a concentrate, which is sent to the Dorr thickener-tanks, for settlement—this comes from the first three cells of the M. S. machines. The rough concentrate from the next six cells of the M. S. machines, is further cleaned in the Callow cells. (See Fig. 3), making a clean concentrate; and the middling, which, with the middlings from the remaining five cells of the M. S. machine, is returned to the feed of the M. S. machines.

About 6 to 8 lb. of 50°B. sulphuric acid, per ton of flotation-feed, is used, together with two to three pounds of kerosene-sludge acid and from one-half to one pound of wood-creosote. A portion of the wood-creosote is added to the head of the Hardinge mills, and the remainder is added at the head of the M. S. machines. The pulp is heated to 60 or 70°F. by steam introduced into the first agitating-box. The method of adding the reagents is unique. The mixer consists of a revolving disc, to the circumference of which are attached a number of cups. The disc is set vertically, so that its lower edge dips into the pan of acid, or oil; as the disc revolves the cups are filled, and later discharge their contents into a suitable launder leading to the flotation machines. The disc is driven by the friction of a wheel against another disc attached to the main drive. The wheel is run at constant speed and any variations in feed can be made by changing the point of contact between the wheel and the disc. In addition to the speed regulation, the amount of acid, or oil, fed may be varied by changing the number of cups, or the size of the cups.

On account of lack of space in the old mill, now being re-modeled for flotation, an auxiliary plant has to be installed to handle the extra slime from the mill. This is now under construction and will consist of 20 M. S. machines of the same type as those now in use. Fourteen of these will be required for treating the current slime from the mill; the remaining six will treat old slime from the dump. This will be brought from the dump dry and mixed with water before treatment in the machines. The capacity for the dump-slime is about 1000 tons per day. No Callow cleaners are to be used in this plant.

The concentrate from the flotation machines is thickened to about 60% solid in Dorr tanks, 50 by 12 ft., the spigot-product of which goes to 11½-ft. diam. by 12-ft. face, Oliver filters (see Fig. 4), each having a capacity of about 150 tons daily.

The cake from the filters contains about 18% moisture and will be fed onto a conveyor carrying mill-fine concentrate to the new roasting-plant now in process of construction. In this way the filter-cake will be fairly well mixed with the concentrate, so that a generally uniform feed will be obtained for the roasters.

At the present writing two sections (out of eight) of the old mill have been re-modeled to use flotation; and a third section is now nearly ready. The mill is being re-modeled a section at a time by the company's engineering department. Some remarkably rapid work has been accomplished in changing over from one system to the other. For instance, the No. 2 section of the mill was in operation on the 26th day of May for ordinary water-concentration; but was wholly re-constructed and in operation, using the flotation process, on the 26th day of June. Each section has a capacity of 2000 tons of original feed daily. At the present rate of re-construction the entire plant will be re-modeled by January 1, 1916.

Brass cartridges made from impure material do not keep well, but are apt to crack in storage, especially in hot climates.

*Manager for the Anaconda Copper Mining Company.

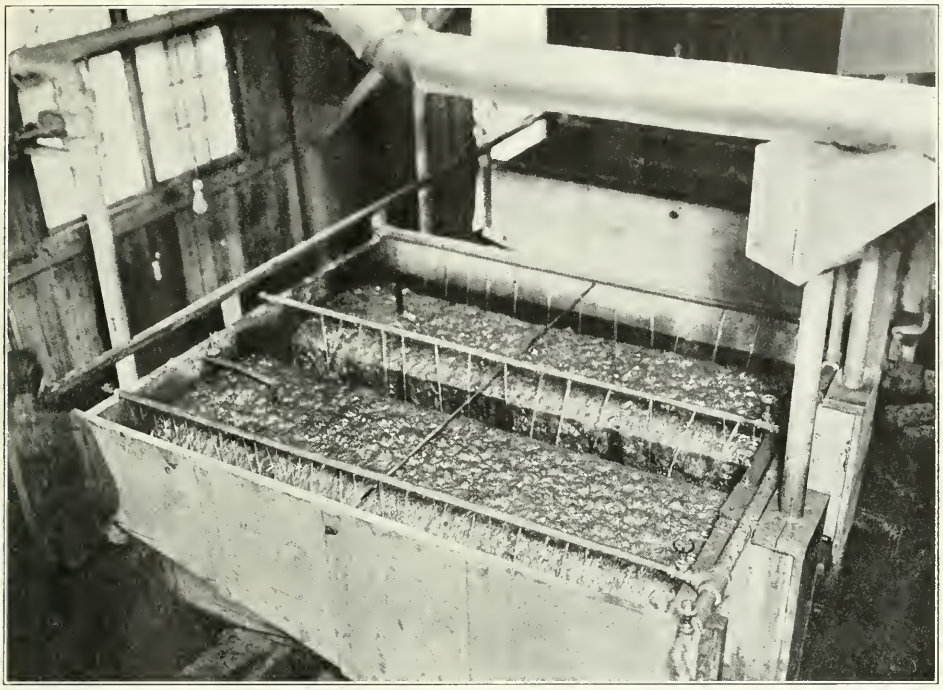


FIG. 3. CALLOW CLEANER, SHOWING THE MINERAL FROTH.

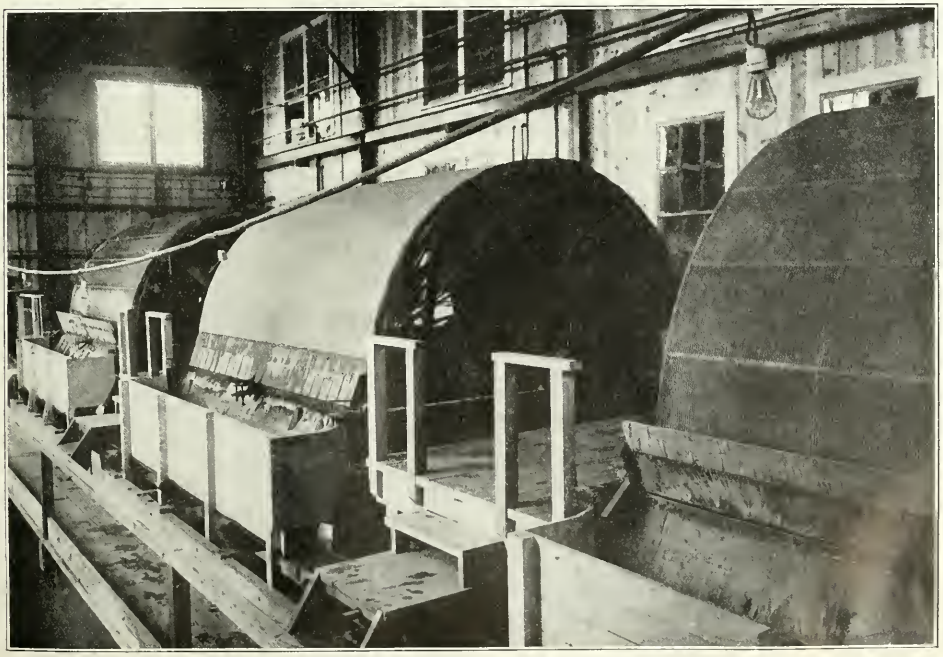


FIG. 4. OLIVER FILTERS FOR DRAINING THE FROTH-CONCENTRATE.

Technical Reminiscences—II

By E. GYBBON SPILSBURY

Long drawn-out litigation between mining companies, while of more common occurrence at the present day, was not unknown in the last generation.* An early experience I went through and which gave me considerable reputation at the time may be of interest to the engineers of today.

In order to make the situation clear it will be necessary to sketch the causes that led up to the litigation.

In the year 1852, the Corphalie Zinc company of Huy, Belgium, was second in importance only to the Vieille Montagne company, and was a prominent factor in the ore-markets of the world. Other companies were being formed and started, and consequently there was considerable competition for the purchase of zinc and lead ores. A new source of supply was being developed in the Eiffel mountains in Rhenish Prussia, and among the numerous operations the oldest and best was that of the Saturne company of Bensberg. The Corphalie company was desirous of acquiring the output of the Saturne company, which was of very desirable quality, and was capable of considerable increase. The Saturne company, however, was not financially strong enough to carry out the necessary improvements and applied to the Corphalie company for a loan of 2,500,000 thalers to be secured by a contract for their entire output. It was the wording of this contract that caused the litigation.

The Saturne company had been operating for ten years previous to the signing of the contract. Their mines produced argentiferous galena, and zinc-blende, which latter also carried silver. As the question of the disposition of the lead products never came into serious dispute, there is no need of considering them further in this story.

The contract for the sale of the zinc ores to Corphalie was for a term of 50 years. In order to arrive at a basis for the selling-price, the operations of the Saturne company for the previous 10 years were taken, and it was found that the lowest percentage of zinc in any of their shipments was 28%, while the highest had reached 53%. A sliding schedule, based on the quotations of the Breslau zinc market for the month of delivery, was worked out for each percentage of zinc content between 28 and 53%, it being stipulated that the price for any ores carrying less than 28% zinc or more than 53% should be mutually arranged, if any such grade of ore were produced in the future.

*[Probably the Comstock Lode holds the record for expensive litigation. A special chapter is devoted to the "interminable litigation" in Eliot Lord's 'Comstock Mines & Miners' wherein it is stated that $10,000,000 was expended in litigation prior to 1866.—EDITOR.]

In the beginning this contract proved most satisfactory to both parties. The Saturne company became very prosperous, paid back its loan with interest, and became the largest producer in the Bensberg district.

At the end of five years, however, it became evident that there was a growing increase year by year in the open-market value of zinc ores, which accrued to the Corphalie company to the detriment of the Saturne. This discrepancy between the open-market value and the contract price increased so rapidly that all sorts of negotiations were attempted on the part of the producer to mitigate the losses. Finally, about ten years after the signing of the contract, the Saturne company notified the Corphalie that thence forward they would cease to produce or market any zinc ore falling within the schedules of the contract and that they would sell ore only having less than 28% zinc, or enriched over 53%, and that if Corphalie people desired this class of ore, they would have to bid for it in open market.

The lawsuits resulting from this action were international in character, being carried on both in Belgium and Germany, as the Saturne company was a French corporation with a branch in Belgium. As years went on, intense personal bitterness between the presidents and managers of the two companies was developed and every endeavor at compromise was thereby rendered impossible. In 1868, when I became connected with the matter, everything had reached a deadlock. I had just completed the construction of a small zinc smelter for the Corphalie company at Ivanec, in Croatia, and on my return to headquarters my thorough knowledge of the language caused me to be put in charge of their ore-purchasing in Germany, and so the Saturne imbroglio was handed over to me. This necessitated my studying the old contract; I found among other things a clause in the contract giving Corphalie the right of appointing an engineer who at all times should have free access to the mines and works, laboratories, and books of record and accounts of the Saturne company, and providing that all underground and surface work should be submitted to him for approval. I called the attention of our president to this clause, and asked him whether he had ever taken advantage of it. He laughed and said that was a clause put in all such contracts, but that it could never be enforced. When I differed respectfully from him on this point, he asked me whether I would dare carry out the duties of such a position if the board should appoint me; I replied in the affirmative, provided I was given full power-of-attorney from our company, and that instructions were given to our counsel at Cologne to obtain what protection the Courts would give me under the contract. Within a week I was duly

appointed by our board and commenced one of the most exciting pieces of work any engineer ever undertook.

A formal notice having been served on the Saturne company that we proposed to avail ourselves of the clause in our contract giving us the right of inspection, I duly presented myself at their mine-office and presented my credentials. As I had expected, admission was promptly denied me. I then applied to the Court in Cologne for an order restraining the Saturne company from interference in my work of inspection, under the contract, and after a bitterly contested fight the decision was given in my favor. As there had been threats of personal violence if I persisted in my purpose of constant inspection, I further obtained from the Court the protection of an officer during my visits.

My first objective was a thorough inspection of the mine, so as to determine the actual condition, in extent and composition of the orebodies, and to find out whether for purposes of easier concentration they were leaving portions of orebodies unstoped, which economically ought to have been mined with the rest.

This investigation resulting in finding nothing objectionable in their methods of mining, I turned my attention to the surface operations. Here I found that they were actively engaged in re-modeling their ore-dressing plant, putting in improved grinding machinery and replacing the old straight buddles (*liegende heerde*) by the newly invented Rittinger tables, and the old Cornish buddles by modern revolving tables. After a few days' study of the general scheme of concentrating they had adopted I determined that the only way I could reach any decision as to what was going on, was to thoroughly sample each stage of the operations. I notified them of my intention, and was surprised that they raised no objection. I therefore brought in two assistants, and proceeded to sample the ore coming into the mill. That evening we took our samples home, for shipment to our own laboratory. Early next morning, I was arrested for stealing ore and taken to Cologne for trial. Our counsel had warned me before that they would probably take such action and so bail was ready when I reached Cologne. The case was pushed as quickly as possible, but before it came to trial I had been arrested 14 times on similar charges. The decision of the Court was that as I was acting under an order from the Supreme Court giving me the right of investigation, the taking of samples was a necessary part of my duties and did not constitute larceny.

Assured now of my legal status, I began an aggressive campaign in earnest. I sampled every ton of material coming out of the mill for shipment, and soon became expert enough to tell by sight within one or two per cent the zinc contents of any of their concentrates. The moment I saw a shipment being made of stuff that I felt sure did not exceed 53%, I had that shipment seized and held by the Court until the exact contents could be determined. Several times I fell down in my contention, and had to pay heavy damages, but it was really remarkable how few mistakes of this kind I made after I got accustomed to the appearance of the different grades of concentrate.

The Saturne company's engineers meanwhile were not sleeping, and a more perfect system of sampling and inspection of products from each of the concentrating machines was inaugurated, and every batch of concentrate that did not reach the desired point of concentration was returned to be re-treated. I have known of batches of several car-loads to go through the mill three times in order to raise the zinc contents above 53%, and yet the bulk of it had to be turned over to our company at last.

I don't suppose there ever was a closer study made of just what enrichment could be accomplished by each concentrating machine. Of course, the amount of so-called 'middling' that was produced kept on growing so rapidly under this system that additional crushing machinery had to be installed to take care of it. For 11 months, I never let up one moment in my work, and both the general manager of the Saturne company and myself were worn to a frazzle. It was found that the increased cost of operations due to this fight had been so enormous that for the first time in over 20 years they had not earned their dividend and this called the shareholders' attention to the situation, and caused dissatisfaction. During this prolonged fight, the manager of the Saturne and myself had got to know one another pretty well, and we finally put our heads together and evolved a scheme of compromise, which we succeeded in getting adopted by both companies. They paid us a round sum, not much less than the original loan, in return for the cancellation of the contract, and gave us preference at even prices in the sale of all their products. For my part, I received a formal vote of thanks from the board of our company accompanied with a present of a year's salary.

I consider that the experience gained during that year has been of extreme utility to me in my subsequent career. It taught me the necessity for close attention to the minutest details of any work undertaken, and it also taught me the advantage of mutual concessions in cases of dispute rather than fighting to the bitter end.

In the autumn of 1870 I was called into consultation by the Lehigh Zinc Co. to work out a method of concentrating their low-grade ores. The large surface deposits of calamine (zinc carbonate) ore, which had been the mainstay of their operations, were reaching a point of exhaustion, and in depth a gradual replacement of zinc sulphide was taking place.

This zinc sulphide, so far as I know, was unique in its physical character and was locally known as 'wax blende.' It was a mineral of rather dark greenish hue, non-crystalline, it had a decidedly conchoidal fracture, and in places was difficult to distinguish from the limestone in which it lay; it contained from 64 to 66% zinc, the only other impurity being a trace of iron.

The development of the zinc industry in this country at that time was still very much in its infancy; owing to the richness of the surface ores but little concentration had been necessary.

While engaged in this work I became acquainted with the two men who were the real pioneers in what may be considered the purely American process for the manufacture of zinc oxide direct from the ore, in contradistinction to the European method, where the oxide was produced from the metal. These men were Samuel P. Wetherill, of Philadelphia, and Nathan Bartlett, of Newark, New Jersey. While both of these men claimed the sole invention of the process, the result of the subsequent law-suits to determine priority resulted in awarding the furnace rights to Col. Wetherill, while the method of collecting the oxide fumes in bags, known as the bag-house system, was, I believe, proved to have been the invention of Nathan Bartlett.

During my stay in Bethlehem at that time I began also my life-long friendship with John Fritz, who was the manager of the Bethlehem Iron Co., now the Bethlehem Steel Co. Fritz, under the guidance of Alexander Holley and Robert W. Hunt, was struggling with the introduction of the Bessemer process, and I did a good deal of the analytical work for him. I remember his coming to me one day to ask me whether I did not think a point had been reached where it would pay the company to install a laboratory of their own, and I strongly advised him to do so. Some months later he wrote me that he had followed my advice and would like to show me what a fine laboratory he had established. On my next visit, expressing a desire to see this laboratory, he took me over to the works and, rather to my astonishment, led me to a loft over the company's stable, where his laboratory had been installed, that having been the only available room he had for the purpose at the time. When we compare the present laboratory facilities of the Bethlehem Steel Co. with this first venture of only 45 years ago, it certainly offers a wonderful contrast, though perhaps not more so than the comparison of the works as they now are with their aspect at that date.

The concentration of the carbonate zinc ores at Friedensville, near Bethlehem, having proved successful, I was called upon to install a plant to treat somewhat similar ores at the Sterling Hill deposits of the Passaic Zinc Co., at Franklin Furnace, New Jersey, and thus began my connection with one of the most remarkable mining law-suits that has ever been waged.

The suit in one shape or another lasted over 40 years, and my connection with it, off and on, extended some 12 years. The trouble originally arose from ignorance of the constituent minerals in the enormous outcrops at Mine Hill and Sterling Hill. At Sterling Hill the outcrop was principally red oxide of zinc mixed with a certain amount of franklinite, while the deposit at Mine Hill was apparently franklinite, only with a very small admixture of red oxide. Originally the franklinite was supposed to be a non-magnetic iron ore, and when treated in the blast-furnace had been found to produce an intensely hard pig-iron, due to the high percentage of manganese contained in the ore. This franklinite iron obtained a great reputation in those days for the manufacture of burglar-proof safes.

The original owner of the mining claims covering this deposit formed two companies, selling to each one of them a different grade of ore. To the New Jersey Zinc Co. he sold all the zinc ore on the property, while to the Franklin Iron Co. he sold all of the franklinite ore. For a while there was no question as to what was zinc ore or what was franklinite, because in those days it was supposed that the red oxide of zinc was the only zinc mineral present; later, however, when the big black outcrop in what was known as the Buckwheat Field opening was proved to be, not pure franklinite, but in reality a mixture of willemite and franklinite, the property, which was owned by the Franklin Iron Co., was claimed by the New Jersey Zinc Co. as coming under the specifications of their purchase of the zinc ores.

At the time the deeds were signed—if I remember right, somewhere about the year 1854—franklinite was an entirely new mineral, and it was not supposed that the small percentage of zinc that it contained was really a constituent of the mineral itself, which had therefore been generally classed as an iron ore. Later, after the suit was begun, the New Jersey Zinc Co. proceeded to establish the fact that franklinite was a definite mineral that could not contain more than 21% of zinc, and that therefore all minerals in the deposit containing more zinc than that amount must necessarily fall under the classification of their deed.

On the other hand, the Moses Taylor Iron Co., successors of the original Franklin company, maintained that what had been deeded to them was all the dark-colored ore which had generally been known in those days as franklinite, notwithstanding the fact that later on this black color, which was due principally to surface oxidation of the manganese contents of the ore, disappeared in depth and showed the ore to be willemite.

It took a long time to enable the experts engaged on both sides to prove by actual demonstration that the constituent parts of the orebodies could be separated mechanically into ores commercially valuable for the metals contained in them. It was no difficult thing to separate the crystalline franklinite from the willemite or from the red oxide of zinc, but when in addition it became necessary to separate the manganese minerals, rhodonite and rhodochrosite, from the willemite and the franklinite the difficulties were very greatly increased.

Finally the litigants were brought together on a merger of their interests and the actual points at issue on the main suit were never determined legally. While this compromise resulted in the formation of the present New Jersey Zinc Co., the largest corporation of its kind in the world, it was a good deal of a blow to the legal fraternity and to the experts engaged on both sides, to whom it looked as though they had lost their birthright. It was not till many years later that the economical concentration of these zinc ores was finally made successful by J. P. Wetherill's invention of his system of 'paramagnetic' separation, the development of which has been one of the chief factors in the commercial success of the New Jersey Zinc Company.

The Rochester Mill, Nevada

By G. W. WOOD

The Rochester mill, which was designed by the writer as engineer for the Dorr Cyanide Machinery Co. and started on March 30, 1915, by him, as consulting engineer for the Rochester Mines Co., with C. W. Poole as superintendent in charge of the mine and mill, is probably of general interest from a metallurgical standpoint as a typical installation of a continuous counter-current decantation cyanide plant, operating on silver ore, using Dorr thickeners exclusively without a filter, and embodying throughout a number of details perfected in the operation of older plants that may be regarded as the best previous practice in a plant of this type.

The mill is treating custom ores and for this reason no definite information can be given regarding the extraction now being made other than that the recovery is as complete as is possible in treating an ore of a particular character and that the loss in dissolved value is less than that originally estimated.

Herewith I give the theoretical solution flow-sheet, based on a capacity of 100 tons of ore per day. It follows the lines on which the mill was designed, and with results in actual milling that have conformed closely with expectations. The plant to date, however, has developed a daily capacity of about 120 tons. To simplify the description the capacity is assumed as 100 per day, namely, the tonnage that the mill was originally designed to treat.

All figures refer to solution tonnages.

Calculations for Loss in Dissolved Silver and Gold

Conditions assumed:

(*a*) 100 tons of ore per day crushed in cyanide solution.
(*b*) Discharge from all thickeners with 44.4% moisture.
(*c*) $14 value dissolved per ton of ore.
(*d*) 35% in mill; 55% in first two agitators; 10% in last agitator.
(*e*) 600 tons of solution from thickener U precipitated to 2 cents.
(*f*) Agitation with a dilution of 2 parts of solution to 1 of solid.
(*g*) Let U, V, W, X, Y, and Z represent value in dollars per ton of solution discharged from the respective thickeners.

Equating out of and into each thickener:

(1) $600\ U + 80\ U = 680\ V + (100 \times \$14 \times 0.35)$.
(2) $800\ V + 80\ V = 680\ W + 80\ U + 120\ V + (100 \times \$14 \times 0.55)$.
(3) $680\ W + 80\ W = 80\ V + 480\ X + (100 \times \$14 \times 0.10) + (200 \times 0.02)$.
(4) $480\ X + 80\ X = 80\ W + 80\ Y + (400 \times 0.02)$.
(5) $80\ Y + 80\ Y = 80\ X + 80\ Z$.
(6) $80\ Z + 80\ Z = 80\ Y + (80 \times \$0.00)$.

Simplifying:

(1) $680\ U = 680\ V + 490$
$U = V + 0.7206$
(2) $880\ V = 680\ W + 80\ U + 120\ V + 770$
$V = W + 1.2172$
(3) $760\ W = 80\ V + 480\ X + 144$
$W = 0.7059\ X + 0.3545$
(4) $560\ X = 80\ W + 80\ Y + 8$
$X = 0.1589\ Y + 0.0722$
(5) $160\ Y = 80\ X + 80\ Z$
$Y = 0.5431\ Z + 0.0392$
(6) $160\ Z = 80\ Y$
$Z = 0.5\ Y$

Solving:

(1) $U = 2.3491$
(2) $V = 1.6285$
(3) $W = 0.4114$
(4) $X = 0.0807$
(5) $Y = 0.0538$
(6) $Z = 0.0269$

To check these figures:

The amount precipitated from 600 tons, at $2.3491 — 0.02	$1,397.46
The amount lost in tailing, 80 tons at $0.0269	2.15
	$1,399.61
The amount due to neglected decimals	0.39
	$1,400.00
The amount dissolved, 100 tons at $14	$1,400.00

Calculation for Mechanical Loss of Cyanide

Conditions assumed:

(*a*) Neglect the cyanide consumption throughout the system.
(*b*) Strength of cyanide per ton of solution, 4 pounds.
(*c*) Let U, V, W, X, Y, and Z represent the strength in pounds of cyanide in solution discharged from the respective thickeners.

Equating out of and into each thickener:

(1) $U = 4$
(2) $800\ V + 80\ V = 680\ W + 80\ U + 120\ V$
(3) $680\ W + 80\ W = 480\ X + 80\ V + (200 \times 4)$
(4) $480\ X + 80\ X = 80\ W + 80\ Y + (400 \times 4)$
(5) $80\ Y + 80\ Y = 80\ X + 80\ Z$
(6) $80\ Z + 80\ Z = 80\ Y + 80$ tons of water.

Simplifying:	Solving:
(1) $U = 4$	$U = 4$
(2) $V = 0.8947\ W + 0.4021$	$V = 3.8311$
(3) $W = 0.6973\ X + 1.2088$	$W = 3.8326$
(4) $X = 0.1586\ Y + 3.365$	$X = 3.7628$
(5) $Y = 0.5430\ Z + 1.8274$	$Y = 2.5084$
(6) $Z = 0.5\ Y$	$Z = 1.2542$

$\frac{80\ Z}{100} = 1.0033 =$ mechanical loss of cyanide per ton of ore.

The operation of the mill is as follows: As originally outlined, the ore from the Rochester mine, or from the various 'leasers' shipping to this mill, is delivered from cars of the Nevada Short Line to five 60-ton bins. From these bins it is trammed to the mill in a car of 1½ tons capacity, weighed on a recording-beam scale, and then dumped over a grizzly (1½-in. opening) to a 20 by 10-in.

Blake crusher. The fine from this grizzly goes direct through a fine-ore chute to the boot of a No. 4 Gates bucket-elevator, the oversize passing through the crusher and then dropping into the same chute with the fine from the grizzly to the elevator-boot. From this point the ore is elevated to the top of the sampler. The elevator used in this installation conforms to the original design of the manufacturer, except that malleable-iron buckets were substituted for the standard bucket.

The ore, after being elevated, drops by gravity to a No. 3 single Vezin sampler, which takes out one-tenth. The reject of 90 tons from this sampler falls through a chute direct to the crushed-ore bin, while the cut, or sample of 10 tons, drops to a shaking feeder that retards and distributes it, and thus makes it feed continuously to a 7 by 9-in. Dodge crusher, in order to insure perfect sampling later. After passing through this crusher the sample is again cut by dropping through a No. 2 single Vezin sampler, which takes out one-tenth from the original sample, the reject of 9 tons dropping to the crushed-ore bin, the sample of 1 ton dropping to a second distributing shaking-feeder. This second feeder uniformly feeds the cut or sample to a set of 12 by 12-in. rolls for further crushing. The sample as it drops from these rolls is again cut by passing through a No. 1 single Vezin sampler, which takes the final one-tenth sample. The reject, nine-tenths of a ton, drops to the boot of a 6-in. elevator, which drops it into the crushed-ore bin, and the sample of one-tenth of a ton, or 200 lb., falls into a locked box in the sample-room.

After the lot of ore has been crushed and sampled, the sample is transferred in the presence of a representative of the owner of the ore to an Engelbach crusher, which again grinds it. From this crusher it passes over a series of five riffles, which cut out two separate uniform samples (one for the customer and one for the mill) for moisture and assay, the waste or reject after the sample has been cut-down being put into the boot of the 6-in. elevator, which lifts it into the crushed-ore bin.

The ore, having been crushed and sampled, is then fed by gravity to two suspended tappet-driven feeders, which deliver it to two batteries of five 1550-lb. stamps, each, dropping 100 times per minute. These batteries are fitted throughout with chrome-steel parts and each is driven by a 20-hp. back-geared Bullock motor, with special controller by means of which it is possible to start each battery without recourse to hanging the stems on fingers. The shoes are fastened with hard-pine wedges and no trouble whatever has been experieneed thus far from shoes dropping off.

The ore, which up to this point has been dry, is mixed with cyanide solution as it drops into the batteries, and remains in solution from now on throughout the process for the dissolution and extraction of its gold and silver content, and the dilution of the various strengths of solution with which it comes in contact, until it passes out of the mill as tailing. All flows or transfers of pulp and solution now mentioned throughout the process are continuous and the tonnages given in each case are for 24 hours. The solution added at the batteries is 680 tons daily of the standard mill-solution, which is the clear overflow from No. 2 thickener.

From the batteries, the ore mixed with the solution, or 'pulp,' as it will now be called, flows by gravity through a launder to the feed-trough of a duplex Dorr classifier, made special in size for this mill. This classifier is installed in closed circuit with two 5 by 16-ft. tube-mills. Pulp that is *minus* 200-mesh or finer flows over the discharge end of this classifier to thickener No. 1. The coarse sand that would remain on a 200-mesh screen is carried over the other end of the classifier and drops over an inclined plate to a right- and left-hand screw-conveyor, which feeds it with 33% moisture to the feed-scoops of both tube-mills, or, in case of necessity, all of the pulp may be fed to either tube-mill independently.

The tube-mills are of the trunnion type and fitted with Komata hard-iron liners with manganese-steel ribs. They were adopted for use in this mill after a careful investigation of the various types of liners in use in other plants with authentic information on direct results obtained in each instance over long periods of time. Both tube-mills are driven by a single 100-hp. special-torque Bullock motor, connected to the tube-mill pinion-shafts by Morse silent-chain drives with spring hubs and cut-off couplings.

The pulp discharged from the tube-mills flows by gravity through a launder back again to the feed-trough of the classifier, where further classification of the –200 material is made. The oversize is returned again to the tube-mills for further grinding, and the –200 pulp that has come from the tube-mills mixes with the –200 pulp from the batteries, flows over the slime-discharge end of the classifier through a launder directly to thickener No. 1. The clear overflow from thickener No. 1, which is 600 tons of the solution coming from the classifier per 24 hours, flows into a clarifying-tank and is pumped as pregnant solution to the zinc-boxes, where the silver is precipitated on zinc shaving. Perfect precipitation has been maintained in these zinc-boxes with a barren-solution overflow since the mill started. The clarifying-tank is used merely for precautionary reasons to insure an absolutely clear solution at all times. Sizing tests made on the slime-discharge from the classifier have averaged 94% of *minus* 200-mesh.

From the original laboratory-tests made on the ore, to allow for any possible variation that might occur in actual milling, and in order to have an ample margin of safety, discharges from the various thickeners were calculated with 44.4% moisture. This is the basis used in this description, although subsequent operation in the mill has reduced this percentage of moisture, with corresponding benefit to the general results.

In thickener No. 1 the pulp is settled. The settled pulp, or underflow, from this thickener is pumped continuously through a pipe connecting the discharge-cone of the thickener with an eccentric-driven diaphragm-pump, which elevates it and discharges it into agitator No. 1. Additional mill-solution, or 120 tons daily of the

clear-solution overflow from thickener No. 2, is added to this pulp as it goes into the agitator, in order to dilute to 2 of solution and 1 of solids. This pulp, thus diluted, overflows continuously to agitator No. 2, receiving a total of 48 hours continuous agitation in these two agitators while flowing through them.

From the second agitator the pulp flows to thickener No. 2, where as it goes through the launder to the loading-well it is further diluted and mixed continuously with 680 tons of the clear-solution overflow from thickener No. 3.

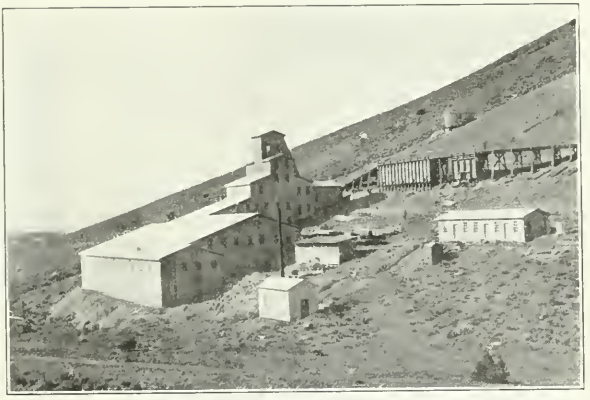
In thickener No. 2 the pulp is again settled and pumped from the discharge-cone into agitator No. 3. Here it is diluted by the addition continuously of 200 tons daily of barren solution from the zinc-boxes; it is given 24 hours' continuous agitation with this charge of solution and simultaneously therewith is discharged continuously to thickener No. 3, where, as it flows to the loading-well, it is diluted and mixed with 480 tons of clear overflow from thickener No. 4. From thickener No. 3 it is pumped over into thickener No. 4 and is diluted as it flows into same with 80 tons of clear overflow from thickener No. 5, together with 400 tons of barren solution from the zinc-boxes. From thickener No. 4 the settled pulp is pumped over into thickener No. 5 and diluted with 80 tons of clear solution from thickener No. 6. From thickener No. 5 it is pumped into thickener No. 6 and diluted with 80 tons of water. From thickener No. 6 the settled pulp is pumped as tailing; the aim at this point being to maintain the discharge at a uniform moisture.

The essential mechanical feature of the process is that all solutions flowing into and out of the respective thickeners must balance each other. This may seem a little complicated, but the manner of doing it has been carefully studied in the various plants already in operation, so that with a few minor adjustments that are necessary in starting a plant, and that are easily made, the mill soon becomes practically automatic.

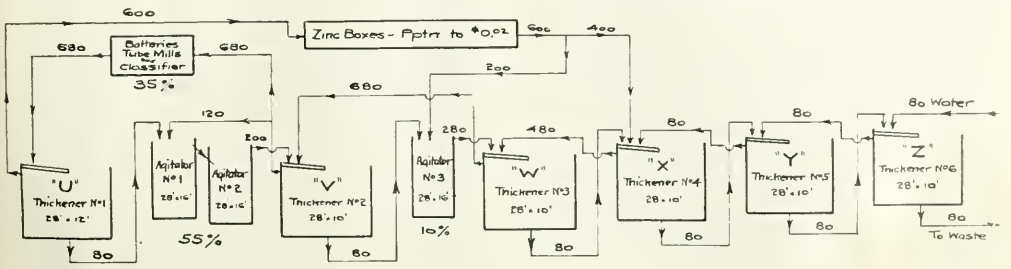
The pumping of pulp in the mill from and to the various thickeners is done with diaphragm-pumps throughout. These I believe preferable to the other method of handling the pulp with air-lifts, as the action of the diaphragm-pumps is more positive. This type of pump requires little attention, its wearing parts are easily and cheaply replaced, and any likelihood of trouble is reduced to a minimum. In starting the plant the capacity of the pumps is first regulated from the length of stroke by means of adjustable double eccentrics capable of giving any length of stroke desired. Slight changes in this original adjustment are made by means of a pet-cock on a small pipe attached to the pipe leading to the suction end of the pump, so as to allow air to enter at this point as desired and thus cut down the capacity of the pump to any required amount.

The tailing is now sampled at half-hour intervals by hand, and the sample collected in each 24-hour period is mixed thoroughly, cut-down, and a washed sample assayed for undissolved loss; while loss in solution is determined by assaying the filtered solution and calculating from it the dissolved loss per ton of solid. With the uniform discharge given by the diaphragm-pump it has been found that sampling such a thick pulp at regular intervals gives reliable results.

In the Rochester mill the successive thickeners are stepped up, which method appears preferable to that of having all the thickeners on the same level, as it permits of the clear overflow solution returning directly by gravity to the respective thickeners preceding them; it eliminates the necessity for air-lifts to transfer these solutions as in the other method; at the same time it sim-



THE ROCHESTER MILL.



FLOW-SHEET OF MILL.

plifies the operation of the plant in other ways and generally speaking makes the transfer of pulp and solution more nearly fool-proof.

The complete equipment for the mill, including that made by the Dorr Cyanide Machinery Co., was furnished by the Allis-Chalmers Manufacturing Co. I wish to express my appreciation of their work in connection with this installation and also that of C. W. Poole as directly instrumental in the success of the plant.

Treatment at the Big Pine, Manhattan

By P. J. QUINN*

†The gold-bearing rock at the Big Pine mine, at Manhattan, Nevada, is a soft schist. The mine is worked by the glory-hole method, the ore dropping into chutes at the 200-ft. level, trammed to the shaft and hoisted to the surface. The gold is free, and, there being no sulphides, it is saved by amalgamation only.

In December 1913, Messrs. Mushett and Wittenberg purchased the Brady mill, consisting of 10 stamps and a 4½ by 16-ft. tube-mill, with two battery-plates and three tube-mill plates, and a cyanide-plant, which was not used on Big Pine ore. For several months, the ore, as broken in the mine, was sent to the mill for treatment. Later, however, it was found more advantageous to crush and screen the ore at the mine, and reduce only the fine material that passed an inch-square opening.

As soon as we began to mill the finer product, Mr. Mushett decided to experiment and see if all grinding could be done in the tube-mill. So the ore was sent from the battery-bins direct to the tube-mill. As a result of these tests the mill to be described was built at the mine and began operating in December 1914:

The ore is crushed in a 10 by 16-in. Blake crusher made by the Joshua Hendy Iron Works of San Francisco, elevated, and passed over an inclined-screen having 1-in. square openings. The oversize is considered waste. The fine ore drops to the mill-ore bin, and is fed to a 5 by 20-ft. Allis-Chalmers tube-mill, working at 28 r.p.m. Attached to the discharge-end of the mill is a trommel made of 6-mesh screen. The material that passes through this screen—more than 99% of the pulp—is distributed over three silver-plated amalgamating-plates. These are 12 ft. long; two of them are 4 ft. 9½ in. wide, and one is 4 ft. 6 in. wide. They have a grade of 1¾ in. per foot. At the bottom of each plate is a trap through which the pulp passes to a Frenier pump. The pulp is elevated to a Dorr simplex-classifier, the coarse going back to the tube-mill. The overflow from the classifier passes over blankets 44 in. wide and 8 ft. long, thence to the tailing-pond. Between 85 and 90% of this residue will pass 200-mesh and it averages 40c. per ton.

No amalgamation is done in the mill; on the contrary, the aim is to keep all amalgam and quicksilver from getting into it. To prevent this, cleats are placed in the launder at the end of each plate, and riffles are fitted in the launder leading from the traps to the Frenier pump. The consumption of quicksilver is very small.

The pebbles used are a local product, known as the Maris. The consumption is 2½ lb. per ton of ore. During March, April, May, and the first 17 days of June, we have ground 11,000 tons of ore, the mill operating 76% of the time.

Space is left between the feeder and the tube-mill for some primary grinder, in case it may be found necessary to install one. Since the crusher is not large enough to produce sufficient ore to insure steady running, a Gates type, K machine, No. 5, is being installed; also a trommel. When these are in operation the mill will have to grind material up to about ⅝ of an inch.

*Superintendent of the Big Pine mill.

†Abstract from *The Tonopah Miner*.

MEDANOS, or crescentic sand-dunes, reach their perfection between Mollendo and Arequipa, Peru. Gazing from his car-window on a plain covered with small pebbles, bare, barren, and wind-swept, the traveler from Mollendo first sees a wagon-load of sand lying by itself. The little heap of sand—a *medano*—is so isolated that his first thought is that some one is going to build a house or is sinking a shaft. Soon other and larger piles of sand are seen—all with clean-swept rocky floors between them. Within a few miles the *medanos* increase in size and number until the whole plain is covered with them. The largest is about 150 ft. long and 30 high; they are beautifully smooth perfect crescents with sharp horns, lying with their convex side toward the sea, from whence they came, and toward the wind. Sixty miles away from the sea, they are still moving onward. In their stately array they seem a vast army; like an army they advance, preserving their regular form as long as they stay on the plain. On climbing a hill they lose their shape and become mere mounds of sand; once over the summit they adjust themselves and again assume a crescentic shape, but hardly as perfect as their original form. Finally, after crossing several hills and valleys they merge in long low dunes. In their progress they cross the railway. Much labor is necessary to keep the tracks clear. In a year they travel perhaps 50 feet. A thin coating of loam stops their progress. They are the result of a wind that blows steadily and gently from the sea for months at a time. Standing near them one can see that a little sand is being blown from the windward side over the crest, whence it falls into the concave side of the crescent. Thus the *medano* is constantly turning and progressing by a sort of rolling motion. Nicely balanced are the forces that produce these beautiful forms. With the wind a little stronger, or blowing less steadily, they would be shapeless dunes that guard so many sea-coasts. A gentler wind would not form them. Travelers who have seen much of the world find these *medanos* the most extraordinary of all physiographic phenomena. A moving picture of these migratory dunes would be of great interest, but as not much motion would be shown in less than 500 years, we are not likely to see it. The *barkans* of Turkestan are said to be crescentic in form, but it is doubtful if they are as perfect as the *medanos*.

The Water-Supply for the Klondike Hydraulic Mines

By H. H. HALL†

*While the earlier discoveries in the Klondike region were along the creeks where a water-supply was easily made available, it was soon found that much ground at a considerable height above the streams contained enough gold to make hydraulic mining a profitable venture. To provide a water-supply, the Yukon Gold Company con-

EXCAVATING DITCH WITH TEAMS.

structed the works hereinafter described. The project involved the construction of seventy miles of conduit from the Ogilvie range of mountains southwesterly to the Klondike mines near Dawson City, for the purpose of conveying 125 second-feet of water, or about 80,000,000

EXCAVATING DITCH WITH STEAM-SHOVEL.

gal. per day. The region traversed lies behind the great Alaskan range of mountains, which are nearly 20,000 ft. high, and cut it off both from the warm, moist air of the Japan current and also from the severe wind storms common along the Alaskan coast. The temperature ranges from 43° to 68° below zero in January to 60° to 95° above zero in July. The country is a low, rolling plateau cut by minor mountain ranges seldom exceeding 7000 ft. in height. It abounds in spruce timber growing as large as two feet in diameter in the river bottoms, but on an average four inches in diameter and 20 ft. high. The top layer of ground is frozen mud, or 'muck,' composed of decayed vegetal matter, frozen as deposited and varying in depth from nothing to several hundred feet. This is overlain by a blanket of moss often a foot or more in thickness, which has the effect of preserving the muck in a frozen condition throughout the year. The chief economic assets of the country are gold and coal, but on the southern slopes, whenever the timber and moss have been burned off, the ground thaws rapidly, and grasses, vegetables, and wild berries grow profusely.

The conduit comprised 21 miles of flume, 37 miles of open ditch, and 12 miles of pipe, constructed under separate organizations during three seasons of about 120 days each, from 1907 to 1909.

Ditch construction was used wherever possible. The

NATIVE TIMBER USED DURING CONSTRUCTION.

ditch was made seven feet wide on bottom and 3½ ft. deep with 1½ :1 slopes. The gradient ranged from four to seven feet to the mile, the greater portion being six feet. The ditch was carefully placed so as to bring the entire working-area in cut. The right-of-way was first cleared of trees, and the muck scraped off with teams and slip-scrapers as fast as it thawed. The latter work presented the most troublesome problem from a construction standpoint owing to the uneven thawing of the muck and the consequent miring of the horses. In some cases, upon the removal of two or three feet of muck from a slope of mixed clay, gravel and ice, the thawing of the upper bank thus exposed started a small slide. This would break the moss above the ditch and allow more thawing, until a strip as much as 200 ft. wide and a quarter of a mile long would start to slide slowly down on the right-

*Abstract of paper read before the San Francisco Association of Members of the American Society of Civil Engineers, April 16, 1915.

†Civil Engineer, 200 Bush street, San Francisco.

of-way, carrying trees and vegetation with it. No preventive was discovered for this.

Thirty miles of ditch was dug with six 30-ton steam shovels, the remainder with horse-scrapers. As the shovels required a working-space at least 16 ft. wide, no side-sloping was done with them. Small quantities of frozen material were removed with 40% dynamite but the larger patches were passed over, and after thawing were taken out with scrapers. The shovels worked two 10-hour shifts and burned about three cords of wood per day. The record performance for one shift was 410 lin. ft. of ditch, or 1200 cu. yd. and the average performance was 14.7 lin. ft. or 51 cu. yd. per working hour, or 11.2 lin. ft. or 38.7 cu. yd. per available hour. The season lasted from June 15 to about October 15, with work usually slow the first and last weeks, 100 working days being about the true season-length. The teams and scrapers accomplished from 8 to 20 yd. per horse-day, averaging about 15 yd.

4 Ft. x 6 Ft. FLUME COST EXPRESSED IN MAN DAYS, (10 HOURS.) PER LINEAL FOOT OF FLUME.

Item.	Man Days.	Remarks
Lumber Hauling.	.159	
Under-Pinning.	.105	Equals about .017 Man Days per Lin. Ft Round Timber.
Survey.	.025	Includes Preliminary.
Clearing	.025	Trees only, equivalent to 11 per acre.
Excavating.	.139	Equals about 5 per Cu Yd.
Bent Construction.	.094	
Back Filling.	.016	
Miscellaneous.	.125	
Flume Construction.	.145	
Superintendance.	.014	
Total.	.847	

General Expense amounted to about 4% of total cost.

TABLE OF FLUME COSTS.

While the actual cost per lin. ft. of ditch was about the same for shovel-work as for scraper-work, it should be remembered that the number of horses in the region was limited. To attempt to construct the entire ditch with horses would have either delayed the completion of the project or else compelled the importation of a large number of animals. The latter course would have added greatly to the cost of the work. The use of steam-shovels was therefore a much greater saving than would appear at first sight from the cost-summary.

The finishing gang followed the shovels, truing the grade, sloping the banks, clearing the berms, building a path along the top of the spoil bank for watchmen, and constructing turnouts and overflows alternately every half-mile. In porous ground, the shovel gang endeavored to keep below grade and the finishing gang filled in the depressions with six inches of moss and a covering of top soil. In soluble materials a trench was dug against the lower bank, extending two feet below grade, and a layer of sheet piling placed over the side of the ditch with a single tie at the top, this piling then being covered with moss and top soil. The average labor cost of finishing per lin. ft. was 0.094 of a man-day plus 0.018 of a horse-day. Common labor was paid $4 per day and board, and horses were hired at $100 per month, including found. Under operation the ditch has proved satisfactory, leaks

YUKON GOLD COMPANY

MAIN PIPE LINES.

Name.	Kind.	Diam.	Length	Head.	Max Pres.
Little 12 Mile.	Wood.	49"	830'	95'	685
	Riveted Steel	44"	3540'		
Ballarat	Wood	42"	13200'	158'	246
	Wood	48"	800'		
Lepine Ridge	Wood.	48"	14800'	108'	133
Lepine Creek.	Wood.	49"	1924'	50'	490
	Riveted Steel.	47"	2160'		
Klondike.	Wood.	49"	2390'	200'	1039
	Riveted Steel.	49"	6850'		
	Welded Steel.	43"	7520'		
Quigley.	Wood	46"	1600'	17'	193
Pure Gold	Wood	35"	1626'	21'	234
Mosquito.	Wood	35"	1560'	22'	256
Bonanza	Spiral Riveted	42"	3175'	91'	364
	Spiral Riveted	38"	3175'		
Adams.	Wood	35"	1907'	30'	270

DATA REGARDING MAIN PIPE-LINES.

SUMMARY OF STEAM SHOVEL OPERATIONS SEASON OF 1908

Shovel.	Start	Finish	Total Hours. (20 per day)	Hrs Lost Moving across pipe line, etc.	Avail Working Hours	Hrs Lost. Repairs, Accidents, Blasting	Hours Worked.	Total Lineal Feet.	Total Cubic Yards.	Lineal Feet Per Hour Worked	Lineal Feet Per Available Hour	Cubic Yards. Per Hour Worked	Cubic Yards. Per Available Hour	Remarks
I. Vulcan "Little Giant"	July 2nd	Aug 19th	970	○ 50	920	44	876	11,296	36356	12.9	12.3	41.5	39.5	○ Crossing Shovel Creek and Sloughs
II. Vulcan "Little Giant"	June 22nd	Aug 16th	1100	○ 20	1080	174	906	12,270	50857	13.5	11.4	56.2	47.1	○ Turning around, Shovel also ran back along ditch digging out high spots.
III. Marion "20" (On Div III)	June 8th	Aug 21st	1460	○ 100	1360	129	1231	● 23,095	82,663	18.8	17.0	67.1	60.8	○ 10 Shifts crossing Ballarat pipe ● 200' digging out flume bottom (Shovel moved to Div V)
III Marion "20" (On Div V)	Aug 25th	Sept 14th	410	○ 35	375	27	348	5,400	11,730	15.5	14.4	33.7	31.3	○ Moving along bank, rains, etc.
IV Victor	June 23rd	Aug 24th	1250	○ 74	1176	462	714	8,975	32,031	12.6	7.6	44.9	27.2	○ Crossing Quigley Pipe Shovel worked through rock, frost, and mud continuously 7/4 to 9/21
V Thew	July 8th	Sept 14th	○ 1434	25	1409	833	576	7,106	26,096	12.3	5.0	45.0	18.5	○ 12 Hr Shifts from 8/4 to 9/9 Shovel worked almost continuously through frost and rock
VI. Vulcan "Little Giant"	June 22nd	Aug 30th	○ 1190	——	1190	92	1098	16,340	50,851	14.9	13.7	46.3	42.7	○ 12 Hr Shifts from 8/5 to 9/10 Shovel idle from 9/10 to 9/21 — crew on Shovel II.
Totals.			7814	304	7510	1761	5749	84482	290584	14.7	11.2	51.0	38.7	

being usually caused by ice seams. These breaks cannot be re-filled, and where they occur, flume construction has to be substituted. Caving banks were protected by brush laid lengthwise with tops up-stream, held in place by stakes.

Where the side-slopes exceeded 15° or the muck was over 2 ft. thick, flume construction was adopted of board-and-batten type and was 6 by 4 ft. The flume was built of native lumber, made up in 16-ft. sections and set on

WEAK POINT IN DITCH, LINED WITH TIMBER.

trestle-bents of hewn timber 8 ft. centre to centre. Most of the bents were carried on mudsills laid below the black muck, or about four feet deep, great care being taken not to disturb the moss-blanket unnecessarily and to replace it as quickly as possible over the back-filling in order to preserve the ground in a frozen condition. Even at that

HYDRAULIC MINE.

the ground thawed so rapidly that the workmen were forced to work in mud and water. The cost of excavation was sometimes as great as $5 per cubic yard. Winter-work was tried, but the snow rendered it uneconomical. The bents cost nearly $20 apiece in place. An attempt was made to space the bents 16 ft. centre to centre, but this was found to be impracticable on account of the softness of the foundation.

The experiment was tried of supporting some of the bents on piles driven into earth that had previously been thawed out by means of 16-ft. miner's steam-points. In this manner the moss was broken only to admit the pile, and if allowed to stand a winter before water was turned in, the ground around the pile froze and returned to its original state. Where the depth of muck would require deep mudsill-pits, gravel ballast was placed directly on top of the moss and the flume-stringers were laid on ties as are the rails in railroad construction. The labor cost in man-days of 10 hours per lineal foot of flume were as follows: hauling flume lumber, 0.159; getting out timber for bents, 0.105; surveying, 0.025; clearing out trees, 0.025; excavating, 0.139; bent construction, 0.094; backfilling, 0.016; flume construction, 0.145; miscellaneous, 0.125; superintendence, 0.014; total, 0.847. Operation of the flumes for several years has shown that the pile-foundation is the best, the mudsill-bents showing continual settlement, caused by water flowing down the posts, either from the flume or from natural drainage, and thawing the sub-strata.

Pipe lines were employed for pressure sections. Their construction has been described by W. W. Edwards, in Proceedings of the American Society of Civil Engineers for May, 1914. For pressures not exceeding 200 ft., redwood stave-pipe was used; for pressures over 200 ft. and less than 1000 ft., standard riveted pipe; for pressures over 1000 ft., lap-welded steel pipe. One section was constructed of spiral-riveted pipe with patent bolted couplings.

Under operation it has been found that because of the lines being drained and closed from the first of October to the first of June of the following year, the wood pipe has given considerable trouble. This is particularly true where the pipe was left above ground, the staves drying out and shrinking, necessitating back-cinching practically the entire line before putting it in use each year. The water leaking between the dried-out staves tends to thaw the foundation, causing settlement and opening of joints. This makes a leak that is difficult to repair. As the pipe does not run full all the time, there is an accumulation of drift on the intake end. In spite of the use of grizzly-bars this has worn holes in the wood lines. Some staves have rotted. The sand and gravel carried by the ditch-water has worn the bottom staves badly and all intakes are now provided with sand-boxes. Accumulations of ice at the discharge ends have caused considerable trouble by increasing the pressure on portions of the pipe. The steel pipe has given little trouble, but on high-pressure lines the sediment cuts the steel rapidly and in one instance a ¾-in. rivet was cut away in two weeks.

ORE RESERVES at the Braden mine, Chile, are as follows: Fully developed 66,000,000, probable 20,000,000, possible 27,000,000; a total of 113,000,000 tons. Of this quantity there was in the Fortuna mine 17,000,000, in the Teniente 83,000,000 tons, and in the Regimiento 13,000,000, the grade being 2½% or better.

Cost of Constructing the Tonopah-Belmont Mill

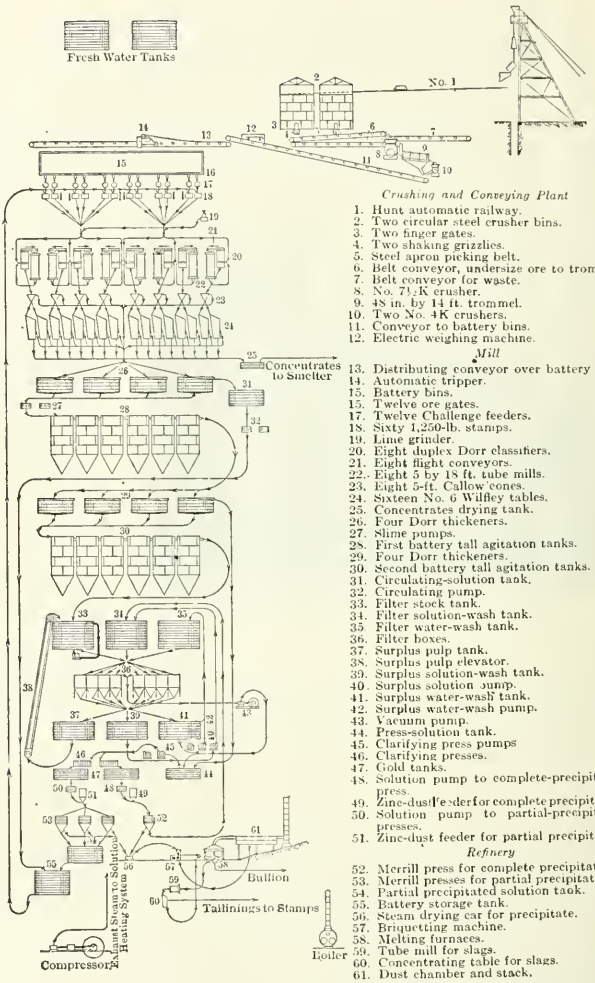
In Bulletin 104 of the A. I. M. E., this plant is described in detail by A. H. Jones, metallurgist for the Tonopah-Belmont Development Co. Although the mill started work in July 1912, it has never been fully described in any technical journal. Excavation commenced in August 1911, about one year being required for its construction under the supervision of Otto Wartenweiler. The accompanying flow-sheet and table show the process of treating the silver-gold ore, and cost of erection, respectively. The total cost of the plant, designed to treat 500 tons per day, was $465,189.07. The saving in operating costs and increased extraction, as compared with the best results from the old plant at Millers, 12 miles away, was such as to return the entire cost of the new plant from the treatment of 260,000 tons of ore, or approximately 18 months' operation.

The extraction from 438,708 tons, up to March 1, 1915, was 96.2% of the gold, 93.0% of the silver, and 93.9% of the money value.

The mill has concrete floors throughout. The grinding and concentrating floors drain to the lower Dorr thickeners, and the lower floors to a common sump from which solution-leaks and overflows can be pumped back into mill-circuit. The initial saving effected by not laying concrete floors is false economy, according to Mr. Jones, as the waste bound to occur in any cyanide-plant will soon exceed the cost of construction.

Everything is driven by electricity, 39 motors consume a monthly total average of 813.69 hp. Of this the crusher and trommel absorb 15.146; 60 stamps, 157.8; classifiers, 8.71; 8 tube-mills, 462.17; concentrators, 9.3; thickeners, 5; circulating pumps, 20.1; agitating pumps, etc., 16.069; filter pumps, 45.94; precipitating department, 33.63; assaying, 2.791; refining, 1.835; machine-shop, 5.36; and lighting, 12.45 hp. The horse-power per ton milled is 1.627.

The total cost of treatment during the financial year 1914-15, when this mill treated 181,424 tons of ore, assaying 22.3 oz. silver, and 0.2336 oz. gold, was $2.156 per ton. In July 1915, the plant treated 14,020 tons yielding 253,420 oz., and a profit of $72,459.



Crushing and Conveying Plant

1. Hunt automatic railway.
2. Two circular steel crusher bins.
3. Two finger gates.
4. Two shaking grizzlies.
5. Steel apron picking belt.
6. Belt conveyor, undersize ore to trommel
7. Belt conveyor for waste.
8. No. 7½K crusher.
9. 48 in. by 14 ft. trommel.
10. Two No. 4K crushers.
11. Conveyor to battery bins.
12. Electric weighing machine.

Mill

13. Distributing conveyor over battery bins.
14. Automatic tripper.
15. Battery bins.
15. Twelve ore gates.
17. Twelve Challenge feeders.
18. Sixty 1,250-lb. stamps.
19. Lime grinder.
20. Eight duplex Dorr classifiers.
21. Eight flight conveyors.
22. Eight 5 by 18 ft. tube mills.
23. Eight 6-ft. Callow cones.
24. Sixteen No. 6 Wilfley tables.
25. Concentrates drying tank.
26. Four Dorr thickeners.
27. Slime pumps.
28. First battery tall agitation tanks.
29. Four Dorr thickeners.
30. Second battery tall agitation tanks.
31. Circulating-solution tank.
32. Circulating pump.
33. Filter stock tank.
34. Filter solution-wash tank.
35. Filter water-wash tank.
36. Filter boxes.
37. Surplus pulp tank.
38. Surplus pulp elevator.
39. Surplus solution-wash tank.
40. Surplus solution sump.
41. Surplus water-wash tank.
42. Surplus water-wash pump.
43. Vacuum pump.
44. Press-solution tank.
45. Clarifying press pumps
46. Clarifying presses.
47. Gold tanks.
48. Solution pump to complete-precipitation press.
49. Zinc-dust feeder for complete precipitation.
50. Solution pump to partial-precipitation presses.
51. Zinc-dust feeder for partial precipitation.

Refinery

52. Merrill press for complete precipitation
53. Merrill presses for partial precipitation.
54. Partial precipitated solution tank.
55. Battery storage tank.
56. Steam drying car for precipitate.
57. Briquetting machine.
58. Melting furnaces.
59. Tube mill for slags.
60. Concentrating table for slags.
61. Dust chamber and stack.

	Excavation Concrete Walls and Foundations	Floors and Machinery Foundations	Buildings		Machinery, Including Erection, Piping, Wiring, Belting, Etc.	Totals
			Frames	Covering		
Crusher plant	$5,760.72	$2,527.58	$2,230.72	$1,476.69	$21,174.96	$33,170.67
Inclined conveyor	166.41	238.02	1,771.75	585.19	3,620.79	6,382.16
Battery bins	399.00	489.70		2,067.69	3,475.14	6,431.53
Stamps		8,797.82			36,873.06	45,670.88
Tube mills and classifiers		3,180.95			40,127.89	43,308.84
Callow cones		26.02			856.63	882.65
Concentrating plant		1,663.23			11,356.35	13,019.58
Concentrate house	76.80	449.69	354.80	623.27	602.10	2,106.66
Dorr thickeners		11,297.98			15,034.53	26,332.51
Circulating system		117.81			6,846.05	6,993.86
Air agitation	261.71	3,987.80			25,257.89	29,507.40
Clarifying		1,829.63			8,573.87	10,403.50
Precipitation system	393.00	44.05			29,581.02	30,020.07
Briquetting plant					1,589.49	1,589.49
Air compressor		1,084.39			7,094.52	8,178.91
Filter plant		4,456.68			30,104.50	34,561.18
Refinery	2,473.84	1,552.23	2,200.17	2,292.80	7,548.79	16,067.83
Boiler plant and fuel-oil system	571.56	90.97	401.25	531.11	7,606.28	9,201.17
Tank-heating system		9.56			3,362.39	3,371.95
Transformer house	91.83	101.05	428.69	213.07	4,804.89	5,639.53
Lime house	11.00			753.30	305.85	1,070.15
Machine shop	1,297.66	843.01	1,138.73	1,191.93	339.56	4,810.69
Storeroom	511.55	1,509.60	1,305.84	1,315.78	152.04	4,794.81
Inclined railway	133.25		432.70	203.41	379.51	1,148.87
Mill building	39,645.45	6,757.60	45,493.48	19,607.14	9,020.51	120,524.18
Total	$51,795.78	$51,085.37	$55,758.13	$30,861.38	$275,688.41	$465,189.07

The History of Gold Mining in the Philippines

*According to Chinese historians, Luzon was noted for gold as early as the third Century, when it was the chief article of export to China.

The regions that were most famous in antiquity are the leading mining districts of today. Morga, writing more than 300 years ago, spoke of the rich gold mines of northern Luzon as being guarded by the savages of the region in order that no Spaniards might learn their situation. Undoubtedly the mines in operation today in Benguet are in the region forbidden to the earliest Spanish explorers. Hernando Riquel made the following enthusiastic statement in his "very true and certain account of what has recently (1574) been known concerning the new islands of the west:"

"There are many mines of gold in many parts (of Luzon) which have been seen by the Spaniards, and all say that the natives work it as they work silver mines in New Spain (Mexico). And the metal has a continuous vein like silver ore. Trials have been made and the mineral presents itself so plentifully that I hesitate to write about it lest they should suspect me of exaggeration; but it is sufficient to say that I swear as a Christian that there is more gold in this island than there is iron in Biscay."

The placers at Paracale were undoubtedly worked before Spanish occupation, perhaps even more energetically than afterward. In 1578, according to official reports, the people of Mambulao and Paracale subsisted entirely upon the profits of mining, although they worked without intelligence and without industry. The Philippine production of gold in Morga's time (1609) was about $200,000 annually, apparently, and nearly all of this amount must have come from Paracale and Mambulao.

William Ashburner, a celebrated American mining engineer, examined properties in Surigao together with the lode-gold on the island of Panaon, about the year 1883. He learned that in Surigao the natives were taking out about $20,000 per year, but he was not induced to recommend the region to his principals.

One of the most romantic episodes in the history of Spanish mining in the Philippines is the career of the famous Ancla de Oro, a company which was established to exploit the Veta Real at Mambulao. This company planned to obtain access to the vein below ground-water level by constructing a sea-level drainage-adit. The prospectus describes the vein on the Benditas Animas, a claim that had been bought and sold as early as 1788. The vein was said to be "two palms" wide, the quartz of it being literally "bedizened" with gold until it "has the appearance of the richest altar hanging," and not only the vein but "the adjacent walls are also gold-bearing." The document ends with the following stirring appeal:

"To those who love their country the opportunity now presents itself to show that they interest themselves in her progress and welfare. One hundred pesos is the cost of a share, payable in four installments. Even if our hopes which are fundamentally so conservative should not be realized, the loss of one hundred pesos will bankrupt no one, so we have no doubt that all will take shares in the enterprise which is this day initiated.—Manila, March 19, 1848, Isidro Sainz de Baranda."

The Ancla de Oro failed ultimately after a long and aggressive effort to extract gold from the refractory ores. The well-preserved portal of their drainage-adit may still be seen and is usually the first evidence of mining to catch the eye of those who enter Mambulao Bay by steamship. The adit itself, however, is caved a short distance from the entrance.

The Spanish government appears to have done as much

*Abstract of a paper by Wallace E. Pratt in the Philippine Mining Bulletin of May 1915.

as it could to promote the gold-mining industry. As early as 1636 the privileges of miners in the Philippines were especially safeguarded by royal decree. Legal procedure for the alienation of mining titles was in effect at a very early date.

On July 1, 1902, the American Government enacted its own mining code for the Philippine Islands, providing for the recognition of all genuine Spanish grants. As a matter of fact only 113 Spanish concessions complied with the requirements for approval, and these are in effect under the new law.

The American mining law placed all public land, mineral, forest, or agricultural, in the hands of the Director of Lands, and the Mining Bureau was re-organized as the Division of Mines of the Bureau of Science. In the Division of Mines the Government now maintains—as the re-organization clause summarizes its purposes—a mining, mineralogical, and metallurgical museum and library open to the public at reasonable hours; in effect, a bureau of information concerning the mineral industries of the Philippine Islands.

The American prospector immediately followed the trail of his Spanish predecessor over the old workings of the native. It is a significant thing that with no important exception up to the present time all the discoveries of both Spanish and American miners have been made on the sites of former Filipino activity. Benguet and Camarines soon became American 'diggings;' a little later Masbate and Mindanao were invaded and although prospectors have touched on practically all the larger islands these four districts continue to be the leading gold-producing centres. Quartz mining in Benguet became established more promptly than the operations elsewhere, and in 1907, with three small stamp-mills operating, produced 3888 fine ounces of gold worth approximately 168,600 pesos. Two small mills had also been erected in Masbate. These first mills were designed essentially for the amalgamation process. It soon became apparent, however, that the ore required cyanidation and all the modern mills employ the cyanide method.

A small Risdon dredge started work on the Lanang river, Masbate, in 1905, but it was wrecked by a typhoon before the value of the ground was established. Another of similar type commenced operations about the same time on the Guinobatan river, in the same district, but did not recover enough gold to pay expenses.

The American prospectors in Camarines early recognized the greater accessibility of the placer-gold there as compared with the lode-gold, although the San Mauricio and Tumbaga lode-mines had come into the hands of Americans. A New Zealand dredge began operation on the Paracale river in 1906 and established the future of gold dredging in that district by winning 101,307.60 pesos from 50,244 cubic yards of material. In 1908 the Risdon dredge was brought from the Guinobatan river in Masbate to Paracale and after a period of experimental operation was placed on the Malaguit river, where, in spite of its small capacity, it continued profitable operation until the middle of 1914.

It is beyond the purpose of this sketch to review in detail the trials and difficulties through which American mining in the Philippines has grown to its present considerable proportions. Gold production, which had reached a value of 187,647 pesos in 1907, rose to nearly ₱500,000 in 1909, fell to barely ₱300,000 in 1910, and has reached ₱2,300,000 in 1914. Typhoons destroyed the Headwaters, Benguet Consolidated, and Bua mills in 1910, but the damage is being remedied and the new Benguet mill being re-built during the summer of 1915 should produce enough gold to enable the district to recover its former leading position.

The development of the Philippines mines, thus far, has been due to the prospector and the small capitalist. The mineral deposits of the Archipelago are widespread and a fair proportion of them are valuable. With capital wisely directed by skilled mining engineers there is every prospect for the development of a profitable industry.

Monazite

According to the Bureau of Mines, there exists a possibility that this country's resources of monazite can be used profitably in the manufacture of the chemical products, thorium and mesothorium. Thorium nitrate is used extensively in the manufacture of incandescent gas mantles; mesothorium has been successfully employed in therapeutics, its properties being similar to those of radium. Most of the monazite imported in late years has come from Brazil, where the mineral occurs in the beach sands along the coast and where it could be mined more cheaply than from inland placers. The mining of monazite in the United States has been practically at a standstill since 1906, especially since the price for thorium nitrate was reduced by European manufacturers to such an extent that it could be imported more cheaply than it could be made here, and this in spite of an import duty of 25% *ad valorem* on the salt. In former years, especially previous to 1906, there existed considerable activity in the monazite belt of North and South Carolina and many hands were employed to mine the mineral. Since then practically no mining of this mineral has been done in these and other states where monazite occurs. It is believed that monazite can be mined in this country more cheaply than heretofore, provided more modern means are employed. Mesothorium can be obtained as a by-product from thorium nitrate manufacture and this may help the American manufacturer to utilize domestic resources at least to some extent.

In Technical Paper No. 110 of the United States Bureau of Mines, Mr. Karl L. Kithil gives a full description and references to occurrences of the mineral in this country and the methods used in the mining of monazite sand are thoroughly discussed, together with flow-sheets and other technical details. A short outline of analyses for thorium is given, as well as methods employed in the chemical manufacture of thorium nitrate and mesothorium.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Sulphuric acid weaker than 66°B., or 1.84 specific gravity, should not be put in iron drums, as they will be attacked by the acid.

A carborundum lining is used in the Rockwell double-compartment gold-precipitate melting-furnaces at the Belmont mill, Tonopah. To line one compartment costs $148, including labor.

Lubricating oil for internal-combustion engines must be of good quality, suitable for the particular engine, and supplied in correct quantity, while the lubrication system should be properly designed. The splash system is generally used.

A radiograph of a metal only gives the gross structure, and no information as to the 'grain.' It does, however, give valuable data as to the presence of blow-holes, slag inclusions, porous spots and defects of like nature, which could not be found otherwise except by cutting into the metal.

The saloon breaks up the monotony of the life in mining villages, and to compete with it or to replace it, it is necessary to find a force of equal or greater social value, according to a writer in the *Coal Age*. Such a place must be more than a house; it must be in a sense a home and have someone who will sustain and control its activities.

The length of rope to be allowed for a loop when attaching clips depends largely on the number of clips to be used, which in turn depends upon the loads to be handled. This length will vary from 30 to 35 times the diameter of the rope; that is, for a 1-in. rope, from 30 to 35 inches should be allowed for the short end after passing around the thimble.

Wood fuel is used for assaying at the Yuanmi mine, Western Australia, on account of the high cost of coke and charcoal. An increased grate area and depth of fuel is required in the crucible and cupelling furnaces. Comparing the cost of wood with coke and charcoal previously used, the longer life of crucibles and muffles, the saving is about $58 per month.

Range in the Lake Superior region is a term applied to a deposit of iron ore and the associated rocks. It originated from the finding of ridges or ranges formed by the wearing of the softer rocks while the hard rocks in which the iron ore is found made ridges, or low ranges. Now the term simply means deposits of iron ore, which are all known as 'ranges,' even if the ground where they occur be low swamps.

Cadger is defined by the Oxford dictionary as "a carrier, itinerant dealer in eggs, butter, etc., between remote farms and towns; street hawker, beggar, loafer." When an important mining company sent an order for "6 doz. cadgers" the above definition did not seem to fit. Only after much telephoning to various hardware dealers was an informant found who explained: "Know what they are? Why yes! We sell hundreds of them. They are a little pocket oil-can for miners."

Minnesota iron ores occur in vertical or steeply dipping lenses that have a maximum width of 400 or 500 ft. and a maximum depth of 1000 ft. Some of these lenses are more than half a mile long on the strike. The Mesabi range is 100 miles long and 1 to 3 miles wide. The Hull-Rust open-pit at Hibbing is the largest iron mine in the world; in 1913 its output was 3,500,000 long tons of ore. The iron ore of the Mesabi is contained in the Biwabik formation, which consists of ferruginous chert, iron ore, slate, iron silicates, and carbonate rocks. Its average thickness is 800 ft., but owing to the low dip it is exposed from a quarter of a mile to three miles wide.

Explosives may be defined as solid or liquid substances that under certain influences, such as heat or shock, resolve themselves instantly into a gas. The commercial explosives are all solids. The gas produced, expands by heat to several hundred times the volume of the solid matter and on the completeness and rapidity of the change depends the power of the explosive and its suitability for special purposes. Explosives are 'high' or 'low.' The high explosive requires a detonator, usually mercuric fulminate, while the low explosive needs simple ignition. Black powder was the original explosive and was made of villainous saltpetre, charcoal, and sulphur for 500 years. The first smokeless powder was invented in 1884 by Vieille in France. One of the latest powders, 'Turpenite' has a poisonous effect; it probably contains cyanogen.

Explorers in former years have been unable to determine longitude with accuracy, the error in determination frequently amounted to degrees. Wireless telegraphy apparatus that can be carried on the backs of men without difficulty now enables longitude to be determined with precision. The Bolivia-Brazil Boundary Commission used the following: (*a*) A seven-stranded aerial wire of phosphor-bronze 1200 ft. long. (*b*) A 190-turn box inductance, rolled in square form with bottom attached. This was used as a carrier for the outfit. (*c*) An ordinary type loose-coupled Martini jigger; oscillation transformer. (*d*) Two dry-cells. (*e*) One pair ordinary Schmidt-Wilkes telephones. (*f*) Several hastily made small inductance coils for use as necessary, according to length of aerial erected. The wire was stretched between trees, as high as possible and pointing to the station from which the signals were expected. With this simple apparatus signals were received from Washington and from Brazilian stations. The closeness of the longitudes thus determined is phenomenal. Two determinations of the longitude of Porto Velho were: from Manaos, Brazil, 4H 15M 38.7S W. of Greenwich; from Washington (one night only), 4H 15M 38.5S.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

TOLOVANA, ALASKA

CONDITIONS AND PROSPECTS OF THE NEWEST OF ALASKA'S GOLD DISTRICTS.

The Tolovana district is situated 55 miles northwest in an air-line from Fairbanks, and is the area included between meridians 148°20′ and 148°40′ and the parallels 65°20′ and 65°40′. The discovery was made on Livengood creek in about the centre of this area during the summer of 1914 by J. Livengood and J. Hudson, but news of the 'strike' did not become public until late in the fall, when, with true Alaskan spirit, everybody in the surrounding districts stampeded. Every creek in the district was located; a snow-road was built from Olness and a rush was made with dog-teams and horses. By the first of April 1915, good prospects had been discovered on Livengood, Wilber, and Olive creeks, all tributaries of the Tolovana river and also on Myrtle creek, a tributary of Livengood, also on Mike Hess creek, a tributary of the Yukon river, and on Alabama creek, which flows into the Mike Hess at present, but at a very recent time geologically was the upper part of Livengood creek and is separated from it at present by a flat ridge only a few feet higher than the bed of Mike Hess creek, which was no doubt a terminal moraine not very long ago.

There is a strong contrast between the topography of the Tolovana and Fairbanks districts. The country is more broken with narrow serrate ridges and steep slopes, mostly bare of timber at the higher elevations.

In the valleys there is an abundance of timber for present needs, and two saw-mills are already under construction on the Tolovana river within ten miles of the Discovery claim.

The rocks of this area are composed of closely folded slate, chert, quartzite, conglomerate, greenstone, and limestone, no doubt of the Paleozoic age, as they have the same general characteristics as rocks so classified by U. S. G. S. Bulletin 442, but this area has never been mapped.

The main ridges are bare of timber and moss. Changes in the rocks can be noticed at short intervals, from limestone to quartzite, then to slate. In one place on the ridge south of Livengood creek, typical 'pencil slate' as found in the Mother Lode region of California makes its appearance and farther on a dike of serpentine (greenstone) 300 ft. wide crosses the ridge and is eroded away for about two miles. This forms the bed of Amy creek, the upper tributary on the right limit of Livengood creek and it is this dike no doubt that furnished the greenstone gravel that is found in all the channels farther down.

Prospecting has been done continually for quartz veins, for it has been assumed by the prospectors that Livengood creek received its gold from quartz veins, as the creeks did in the Fairbanks district, but as no quartz-gravel is noticed and no veins have been uncovered the source of the gold remains a matter of doubt.

The bedrock is a silicious slate (argilite) which is very much fractured and cut by small quartz stringers varying in width from microscopic to as much as an eighth of an inch in width and at irregular distances apart. While these stringers usually show no signs of mineralization, the writer, Clarence Woods, was able, in several places, to see some sulphides, and in a few places the quartz stringers were entirely replaced by stringers of iron pyrite. From the wide distribution of this character of bedrock and the lack of any quartz-gravel, he was led to believe that time will prove that the gold was derived from the argilite, which forms the bedrock of the district.

Livengood creek is the principal creek at present. The gold-bearing part is about 10 miles long and from 1 to 3 miles wide, rim to rim. Gold is found practically anywhere along the present creek-channel, but not in sufficient quantity to attract much attention except on Lillian, the first gulch on the right limit, and on Ruth gulch, which flows into Livengood creek on the right limit at Discovery, which is five miles above the Tolovana river. Other work is being done along the present creek-channel, but so far nothing has been found that would pay.

At present there are three distinct pay-streaks on the left limit; on the first tier bench, Kinney and Franklin on Five Horse are taking out gravel and sluicing it. The results of their work cannot be determined until the clean-up. There are several other places along this bench that prospect, but no other works of any size. On the second tier bench on Six Above, Gustavison is taking out gravel with a windlass and dumping it directly into the sluice, but the pay-streak is narrow and it will require considerable work to determine its value. On the third tier bench, the main pay-streak has been located at intervals for about six miles and there are leases being let and work being done all along the line of this 'pay' and developments are being anxiously awaited.

At present the pay-streak is opened up in seven places and the results of panning are practically the same in each case, although in some places the pay is too narrow to work at a profit at present, but any of these places from Sixteen Above, where Allenwell & Batten have gravel worth $1.50 per square foot of bedrock, to One Below, where Hedstrom & Hudson have similar pay, it can be expected that pay-gravel in quantities will be opened up.

Harry Patterson and associates on the deep-channel claim on the third tier bench, opposite Six Above, have made the only clean-up so far reported and it amounted to 130 oz. valued at $2350, which gave an average of $1.50 per square foot of bedrock, which was about what was estimated. The gold is coarse, one nugget weighing over six dollars, and the pay-streak at this place is opened to a width of 140 ft., and is 80 ft. deep.

At present the gulches on the left limit will furnish water for sluicing, but as the camp develops it will be necessary to build a ditch from Mike Hess creek, which will furnish water for all future needs. A survey is being made for this purpose.

There are three ways of getting into the district. One is by way of Rampart, but the trail is dim and there are no road-houses. Only a few men come in this way, as there is danger of getting lost. Most people who 'mush' in come by way of Olness, a point on the Tanana Valley railroad, 21 miles from Fairbanks. This is known as the Olness trail and it is 55 miles to Livengood creek. To any novice who desires to try a difficult 'mush,' the writer can recommend this 55 miles of 'nigger-heads.' At present it is impossible to get pack-horses or teams over this trail, but last winter they say it was a very good snow-road, and all the equipment and supplies used were brought in over it by dog-teams or horses.

Surveys are now being made for a good winter-road from Fairbanks.

The water-route is used altogether for freight at present. The rate from Fairbanks to the mouth of Livengood creek

is $7 per 100 lb., and from the river to Discovery $3.50 per 100 lb. for packing on horses. Good-sized loads can go direct from Fairbanks to the log jam, 120 miles above the mouth of the Tolovana river. Here a portage of 2100 ft. is made and the remainder of the trip, about 55 miles, can be made in small gasoline launches or poling boats.

As the demand for freight increases, the rate will be materially cut and the mouth of West Fork will be the end of the boat-haul, as there is now a wagon-road being built to Discovery, a distance of 11 miles.

Food and supplies have been hard to get owing to the delays in shipment, but the prospectors have managed to get along and the occasional visitor can always obtain a bed and good substantial camp-food with the addition of a choise cut of moose-meat. As long as the moose last Tolovana can always have fresh beef, and that is more than can be said of many places in Alaska and elsewhere.

The district will undoubtedly produce considerable gold, but owing to its source the pay-streak may be spotty. From all indications the district should make good by itself, as no outside capital seems to be interested.

VICTORIA, BRITISH COLUMBIA

PRESENT MINING ACTIVITIES TROUGHOUT THE PROVINCE BRIEFLY DESCRIBED.

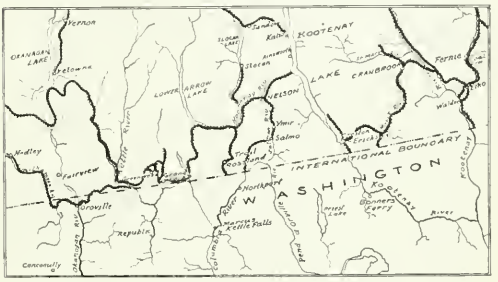
The extent to which the War has affected production of ore in the Kootenay districts is shown in the following table, which gives receipts at the Consolidated Mining & Smelting Co.'s plant at Trail, to which is usually shipped most of the ore and concentrate produced in East and West Kootenay, excepting zinc ore and concentrate, which usually find a market in the United States:

Districts.	7 months of 1915, tons.	7 months of 1914, tons.
East Kootenay	25,314	14,404
West Kootenay:		
Ainsworth division	3,843	11,856
Slocan division	4,006	12,549
Nelson division	2,182	17,119
Trail Creek division (Rossland)	198,191	145,386
Lardeau division	85	84
Boundary	428	283
Kamloops	413	289
Coast	128	828
Total from B. C. mines	234,590	202,798
Alberta	10	.....
State of Washington	17,479	9,464
Total	252,079	212,262

The figures show a net gain of about 40,000 tons to the end of July 1915.

In regard to the decreases, the mines in Ainsworth division that were chiefly affected by the low prices of metal in August 1914, were the Bluebell, producing lead ore, and the Highland and No. 1, silver-lead ore. Of these, the No. 1 resumed shipping ore last March; and at the Bluebell preparations for resumption are in progress, so that only the Highland of last year's larger producers remains off the shipping list. Of the 8500 tons decrease from Slocan mines, 7500 tons was the difference in output of the Standard silver-lead mines, which a few weeks ago resumed its former shipping rate, so that the Slocan division is now making nearly as large an output of ore as it was before the War. Of the 15,000 tons shortage from mines in Nelson division, 13,000 tons is the difference in output of the Silver King, a silver-copper mine controlled by the Consolidated company, which will resume production from it whenever it will be advantageous to do so. Of the increases mentioned above, that from East Kootenay was from the Consolidated company's Sullivan Group lead mine, which in recent years has taken the place of the same company's St. Eugene mine, also in East Kootenay, which previously had been the largest producer of lead in Canada; while that from Trail Creek division was from the Centre Star-War Eagle group, and the Le Roi, all gold-copper mines owned by the Consolidated. The Washington State mines that have this year shipped more freely to Trail are nearly all situated at Republic, Ferry county. They were mostly either inactive during the first half of 1914, or were shipping ore to Boundary district smelters.

The quantity of ore received at the Trail smelter is, however, not the only criterion of progress in mining in the Kootenay and Boundary districts; in fact this does not indicate the position at Boundary mines, as only small shipments of ore have been made from that district to Trail in recent years. The Granby Consolidated company, which is by far the largest producer, has been operating during the current year for several months with its mines and smelters at full ordinary capacity. Published figures show the production of copper from the company's mines at Phoenix to have been during the second quarter of the year more than 4,700,000 lb., compared with only about 3,000,000 lb. during the first quarter. Esti-



PART OF BRITISH COLUMBIA.

mating the output in July at about 1,700,000 lb., the approximate total for seven months, to August 1, may be placed at 9,400,000 lb. This does not include the output from the company's Hidden Creek mine, which is in the Coast district.

One furnace was blown in at the British Columbia Copper Co.'s smelting works at Greenwood in July. Since then the shipment of blister copper to New Jersey has been resumed, after a suspension of production of 11 months.

The only property in the eastern part of Boundary district that continued production in spite of the War is the Jewel gold mine near Greenwood. The 15-stamp mill was operated without interruption.

In Similkameen, in the western part of the area officially known as the Boundary district, the Hedley Gold Mining Co.'s Nickel Plate mines and 40-stamp mill have steadily maintained their customary output of between 3000 to 3500 oz. of fine gold per month. Additions to plant are being made, including a tube-mill, four large treatment vats, a third Oliver filter, and various accessories. The mines are well developed to maintain a regular output.

Reverting to Kootenay district, a brief summary of mining progress is as follows: While there has been some improvement in the demand for coal and coke, colliery employees are not yet working full time. It has been announced that money has been secured for erecting a by-product plant at the coke-ovens of the Crow's Nest Pass Company.

Metalliferous mining in East Kootenay is still of little importance, save only at the Consolidated company's Sullivan Group mine, the output of which has been substantially increased, and at which the outlay on development work continues to be comparatively large. The latest work is a long cross-cut, to provide a protected outlet from the mine, so that

in winter ore may be conveyed to the railway under cover instead of by means of an aerial tramway, as at present.

In several of the mining divisions of West Kootenay there has been gradually increasing activity until many small mines as well as a few larger ones are giving employment to a considerable number of men.

Experiments in concentration of ore from the Silver Hoard have recently given good results. The Florence Mining Co. has opened silver-lead ore that requires facilities for concentrating. This is being considered. On the south fork of Kaslo creek, the Cork-Province mine and concentrator are now producing silver-lead ore and concentrate.——The Utica mine will ship more ore this season than last.——The Whitewater group, now known as the J. L. Retallack & Co.'s mines, is also being worked.

In Slocan division, the Lucky Jim is shipping ore to the Ivanhoe mill at Sandon. The Rambler-Cariboo mine has considerable good ore in sight and is keeping its mill fully supplied.——Development of the Payne is being continued with encouraging results.——The Slocan Star has good-grade silver-lead ore in its lower levels, in addition to an ample supply of concentrating ore available for its mill.——The Ruth-Hope mill is being prepared for continuous operation on ore from that property. The Surprise is sending ore to the Ivanhoe mill and shipping to the United States both silver-lead and zinc concentrates.——Development of the Noble Five continues. A dozen or more small properties throughout central Slocan are having more or less work done on them.

Of mines near Slocan lake, the Standard is the largest producer, and an early resumption of payment of dividends by the Standard Silver-Lead Mining Co. is promised.——The Hewitt mine of the Silverton Mines, Ltd., is maintaining an output equal to the full capacity of the concentrating plant.——Work has been undertaken on the Wakefield and Galena Farm, both of which had been idle for several years. Lower down the lake, the Enterprise, Ottawa, and other well-known mines are each employing a few men.

In the Nelson division present production is chiefly from the Queen and Motherlode gold mines, at Sheep Creek, and from two or three lead mines in the neighborhood of Salmo. There are several small producers of gold in various other parts of this division, and work is also being done on some copper-gold claims; while in the southern part the development of a molybdenite property has been undertaken.

In the Coast district, coal mining is not yet in a flourishing condition, the demand for coal being insufficient to keep the miners fully employed. Copper mining has become much more important than in past years, both at the Britannia mine, in Vancouver mining division, and at the Granby Consolidated company's Hidden Creek mine, near Observatory inlet. The company is putting in a fourth blast-furnace at Anyox, distant a mile or so from its Hidden Creek mines, and is stated to be smelting, with three furnaces, about 2000 tons of ore per day. Copper ore is being shipped from near Hazelton to the Granby works.

Much important construction work and the installation of plant and machinery for the equipment of extensive new underground workings in the mine, and a 1000-ton unit of a new concentrating plant are approaching completion at the Britannia.

Silver-lead claims in other parts of Omineca division are being worked.——Development of the Surf Inlet gold mine, on Princess Royal island, is being continued. The most important mining in other parts of the Coast district is that at the gold-copper mine of the Tacoma Steel Co., on Texada island.

No mention has been made above of placer-gold mining in Cariboo and Atlin fields, but in both there is much activity and an average season's output is expected.

The Pontiac and Sunrise lead-zinc properties between Ainsworth and Kaslo will probably be controlled by C. F. Caldwell of the Utica mine, near the latter place.

TORONTO, ONTARIO

Dome Dividend.—McIntyre Litigation.—Imperial, Dome Lake, Pike Lake.—Cobalt Notes.—Canadian Zinc Co.

The Dome output for July, $131,928, from 28,300 tons of ore, is the best since the beginning of 1914. A dividend of 5% per quarter is to be paid, making an annual disbursement of $800,000.

During July the McIntyre treated 9410 tons of ore averaging $7.89 per ton. The recovery was 96%, and working cost $4.70 per ton. The net profit was $27,600. The general manager states that the large orebody cut at 500 ft. assays $9 per ton. Litigation has been started over the purchase by the McIntyre of the Pearl Lake. An action has been brought by Louis Streuber on behalf of himself and other creditors of the Pearl Lake against B. E. Cartwright and the McIntyre company to have the date set aside. The plaintiff alleges that the sale of the assets of the Pearl Lake company to the defendants for $47,733 was negotiated by a man who acted as a trustee for the creditors and shareholders, and was at the same time, solicitor for Cartwright, and also that Cartwright received 1,000,000 shares of the McIntyre and McIntyre Extension companies, without the knowledge of the assignee, the shareholders, or the creditors.

On the Imperial, a high-grade ore-shoot has been cut at 100 ft. The ore contains free gold and is heavily mineralized. It is stated that the vein is 2½ ft. wide and assays about $15 per ton.

The Dome Lake shipped a gold bar of 200 oz. last week. The mine is reported to be much improved by recent developments at the 400-ft. level, where samples assay as high as $30 per ton.

Two shafts are being sunk on the Pike Lake property, and a large porphyry dike that crosses one of the claims is being stripped.

Cobalt, which has been depressed on account of the low price of silver, now shows some improvement; large shipments of bullion have been made. Several old prospects have been re-opened recently; new companies have been organized. The Gould leasehold, owned by the Peterson Lake, which has been held by several companies, has been turned over to the Mercer Silver Mines, Ltd. The property will be thoroughly explored. W. E. Segsworth is managing director, and A. C. Bailey, manager.

The Kerr Lake has purchased a controlling interest in the Caribou Cobalt, the latter company owning all the stock of the Cobalt Comet, the properties of which adjoin those of the Kerr Lake.

The Canadian Zinc Co., recently incorporated, has acquired a large industrial plant at Welland, Ontario, and contracted for a supply of 1000 hp. of electricity for electric smelting. The first zinc ore treated will be from the United States, but it is proposed ultimately to secure a supply from the mines at Nottingham, Quebec.

At Porcupine the Dome Lake has just shipped its seventeenth bar of gold, estimated to be worth $4000. Development work is being carried on extensively. At the 400-ft. level grab-samples are stated to assay $29 per ton.——It is almost certain that the West Dome property will be re-opened shortly after the meeting of the shareholders to be held on August 20.——A diamond-drill outfit has arrived for the Moneta company.——At the Imperial mine, at the 100-ft. level, a vein has been cut having a width of 30 ft. Much of the ore shows free gold. Two shifts are working.——In the Deloro district, the Porcupine Premier has started to re-open its property. In the past week 14 men have been engaged.

At the Alexo nickel mines near Porcupine, the development indicates possibilities of large orebodies. With a small working force and plant, production for the first six months of 1915 has been 5700 tons of pyrrhotite ore, averaging 5% nickel, together with small quantities of platinum and palladium.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Cordova

Ore and concentrate shipments from the Kennecott company's mines totaled over 9000 tons in July. Most of this came from the Bonanza mine, some of which was 70% ore, the remainder being concentrate. The Jumbo produces 50% smelting ore, and 10% concentrating ore. The Beatson on Latouche island contributes to the output. The yield of the properties this year will be about 70,000,000 lb. The cost is said to be below 5c. per pound.

Juneau

The Treadwell 240-stamp mill started using water power on August 10, the first time for nearly two months.——On August 12, the material on which the Alaska Gastineau company's wharf at Thane was built, slipped and carried away about 10,000 sq. ft. of the wharf. Damage is about $5000. At the end of the wharf there is 30 ft. more water than before the accident. The structure will be re-built. Storms have been a nuisance lately.

Nome

In the case of George D. Schofield *v.* the Nome Consolidated Dredging Co., filed in the District Court on July 24, 16 distinct causes of action are given and the plaintiff asks for judgment on a number of time checks and promissory notes given by the defendant company in lieu of payment for labor and other contracted obligations and assigned to the plaintiff. The notes vary in value from $28 to $316, and total with interest about $2000. The complaint states that the defendant acknowledges the indebtedness, but has failed to pay. The Court is also asked to grant an attorney's fee of $400.

The Wonder and Bourbon dredges and the power-plant on lower Bourbon, were sold by the marshal on July 15. The properties were sold in satisfaction of a judgment obtained in the District Court recently in favor of a number of people represented by Ned Darling and Frank Thatcher as trustees. The purchase price of the properties, which were bid in by E. E. Powell, is to be $20,000.

ARIZONA

Cochise County

The Warren district is the scene of greater activity than at any previous time. Development at the Juniper Flats continues. The Juniper Flats Gold Mining Co. has installed a large crusher in its mill.

Experimenting continues on the ore at the Bunker Hill mine at Tombstone with favorable results. A great deal of construction and overhauling is under way at the property. The great air-compressor, installed by the Tombstone Consolidated, has been re-started. It will supply air for the hoists, the mill, and machine-drills underground. Water in the main shaft has been lowered 70 ft. There are 360 men employed.

Mohave County

A hoist compressor, jackhamers, and other machinery are being installed at the Big Jim company's shaft. When the shaft is down 400 ft. a cross-cut will be driven to cut the Tom Reed vein formation.——Good progress is being made at 200 ft. in the Ivanhoe Consolidated.——The Oatman company's shaft is still in ore which came in at 85 ft. The vein is widening and is of better grade. Chicago people have bought an interest in the property.

Pinal County

The Magma Copper Co. has issued a report to shareholders, dated May 27, 1915. The company's mine is at Superior. To February 1, 1915, a total of 12,311 ft. of development has been done. From this and some stoping there was 44,075 tons of ore extracted, averaging 8.19% copper, 9.37 oz. silver, and 60c. gold per ton. Copper is in the form of chalcocite. Shipments from this ore amounted to 13,250 tons assaying 17.91% copper, 21.52 oz. silver, and $1.80 gold. Net smelter returns were $640,000. This has been spent at the property. The vein has been developed at 500, 650, 725, 800, and 1000 ft. At the lowest depth the shoot is 275 ft. long, being 4.8 ft. wide, containing 14.34% copper and 13.12 oz. silver. There is also a foot-wall copper shoot of lower grade and a zinc shoot between the two. The greatest width of the mineralized zone at 1000 ft. is 60 ft. A new three-compartment shaft will be finished to 1200 ft. by October. Ore reserves are estimated at 95,000 tons averaging 7.6% copper, 8.15 oz. silver, and 56c. gold per ton. A concentrating and flotation plant of 4500-ton monthly capacity has been erected. It is connected with the mine by an aerial tram 2600 ft. long. The mill will not work to capacity until the new shaft is ready. In January and February 1915 it treated 5882 tons of ore, yielding an operating profit of $22,000 each month. Copper was sold at 14.75c. per pound. The haulage of concentrate was 13 miles by team and 17 miles by narrow-gauge railway to the Arizona Eastern line. The total cost was 6.9c. per pound of metal. Power is purchased from the U. S. Reclamation Service at $49 per horse-power year. The company controls the Magma Arizona Railroad Co., which has just constructed a 30-mile narrow-gauge line from the mine at Superior to Webster, on the Arizona Eastern road, 51 miles northwest of the A. S. & R. smelter at Hayden. The profit since January 1 is $78,474 and total surplus $112,541.

Yavapai County

The new smelter at Clarkdale is treating 1400 tons of ore daily. No. 3 blast, and No. 2 reverbatory-furnace, were blown-in last week. This will increase the capacity to 2500 tons.

Work in the Crown King district has been confined during the past three or four years to small syndicates driving adits on veins. Several of them have opened good gold, silver, and lead ores, including the Nelson, Montezuma, Lincoln, Gladiator-War Eagle, and others. As has been mentioned before, it is proposed by Colorado men to drive a long adit to cut most of the veins at depth.

CALIFORNIA

The exact time and place for the meetings of oil operators called by the State Mining Bureau to discuss the new law regulating the drilling of wells is as follows: Coalinga, August 23, Growlers Club, at 3 p.m.; Bakersfield, 25th., Board of Trade, 3 p.m.; Taft, 27th, Petroleum Club, 8 p.m.; Los Angeles, 30th, Bullard building, 2 p.m. (Supreme Court Room); Santa Paula, 31st, City Hall, 1:30 p.m.; Santa Maria, September 1, Office Producers Cementing Co., 3 p.m.; and San Francisco, 3rd, 10th floor Commercial building, 2 p.m.

Amador County

Extensive repairs are being made at the North shaft of the Kennedy mine. An iron water-pipe is being replaced by banded wood-stave pipe.——At the old centre of Aqueduct, J. McFadden has opened rich ore. Renewed interest is being taken in the district.

Butte County

It is reported that the Natomas Consolidated company has designed a boat to re-dredge the Oroville field. No. 1, now working at Thermalito, is to experiment on old tailing at an early date.

It is probable that the Great Western Power Co. will absorb the Oro Electric Corporation, a subsidiary of the Oro Water, Light & Power Co., but the dredges and gravel areas will not be sold.

It is reported that rich quartz has been opened in the Eureka mine, near the Mineral Slide gravel mine near Magalia.—— Some good gravel has been opened in the Oro Fino.

Calaveras County

At the Calaveras copper mine at Copperopolis there are 90 men employed. No. 7 level south drift, north face, shows 9 in. of 18% ore. The remainder of the face is good mill ore.

Inyo County

(Special Correspondence.)—The Wilshire Bisbop Creek company reports that as the result of operations since the resumption of work on Jnne 1, a little over $18,000 has been realized from sales of bullion and concentrate. The latter assays slightly over $250 per ton; they are sent to the U. S. S. M. & R. Co., Utah. The ore yields about $13 per ton, with 84% extraction. The loss is entirely in free gold, and the installation of a slime-table is expected to reduce losses considerably. The ore-shoot averages 26 ft. in width of this, about 9 ft. is $7 ore, and under present circnmstances is not profitable, only 17 ft. wide being mined.

Bishop, August 18.

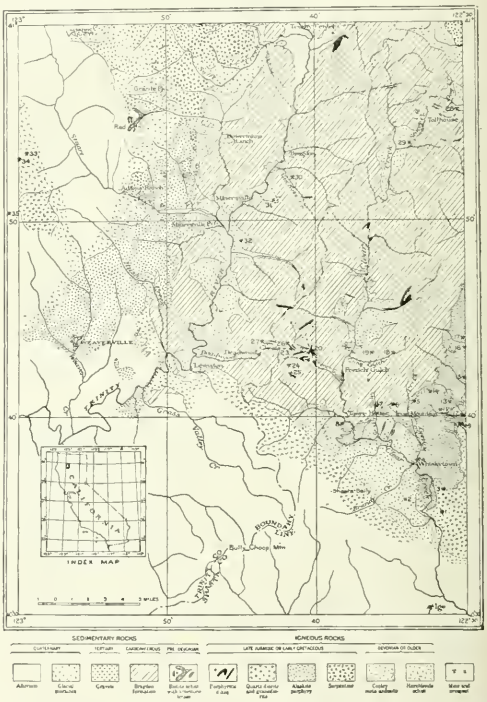
Nevada County

Ore worth about $290,000 is stated by the North Star Mines Co. to have been stolen from its property during the past year or two. Last week two men were arrested at Sacramento with ore worth $1500, alleged to have come from the North Star mine.

Shasta County

The Balaklala Copper Co. has arranged to deliver 250 tons of ore daily at the Mammoth Copper Co.'s smelter at Kennett. S. A. Holman, Jr., is superintendent, and will employ at least 125 men when the mine is re-opened. A compressor, motor, and transformer at the Mammoth company's Stowell mine, three miles southwest of Kennett, were destroyed by fire on August 20. The plant will be renewed.

The pocket deposits of the Klamath mountains are described in the April-May issue of *Economic Geology* by Henry G. Ferguson. The mining districts of these ranges are less known than those of the Sierra Nevada. Shasta, Trinity, and Siskiyou counties produce a total of about $1,750,000 in lode and placer per year. Besides these there are gold deposits of another type, the so-called 'pocket' deposits. Their occurrence in the Weaverville quadrangle is entirely different from the usual vein deposit. Primary mineralization, as distinguished from the secondary process that produced the pockets, followed the quartz-diorite and grano-diorite intrusions. Pockets are found throughout the lowlands of the Klamath Mountain region, where the streams cut below the 4000-ft. plain, but not in the higher mountains. They may occur wherever the contact of black slate with another formation, generally meta-andesite, is exposed, but are not common in the immediate vicinity of the more important primary veins. None is found near the grano-diorite masses. The gold does not occur in quartz but in small calcite lenses between the meta-andesite and slate, between the calcite and slate, and in small specks along the contact without any gangue. Rarely do the pockets occur so close together as to justify continuous mining. The 'pocket-hunter' usually gouges out a pocket, from one dollar to several thonsand dollars, and then moves on to prospect elsewhere. No estimate is possible of the amount of gold obtained from pockets. Old workings are found all along the slate contact, and the most extensive sluicing has been done along those streams that cross the contact, and in many of them no placer work has been done upstream from the contact. The older gravels of the Weaverville basin are singularly deficient in quartz, compared with those of the Sierra Nevada, and probably much of the former's gold-content has been derived from pockets. The Mad Mule and Five Pines mines produce their gold entirely from pockets. The former is three miles north of Whiskeytown, the profitable workings extending from 2300 to 2900 ft. elevation. The pockets occur along the contact of



GEOLOGIC MAP OF PART OF THE WEAVERVILLE QUADRANGLE (U. S. GEOLOGICAL SURVEY).

Mines and prospects as follows: 1. Mt. Shasta. 2. Mountain Monarch. 3. Mascot. 4. Gambrinus. 5. Mad Ox. 6. Mad Mule. 7. Truscott. 8. El Dorado. 9. Minnesota. 10. Hidden Treasure. 11. Iron Mountain. 12. Little Nelly. 13. Hornet. 14 Lone Star. 15. Hardtack. 16. Balaklala. 17. Great Verde. 18. Gladstone. 19. American. 20. Franklin. 21. Milkmaid. 22. Washington. 23. Niagara. 24. Summit. 25. Brunswick. 26. Accident. 27. Brown Bear. 28. Delta. 29 Stacey. 30. Five Pines. 31. Mountain View. 32. Fairview. 33. Globe. 34. Bailey. 35. Craig.

the slate with a dike of diorite porphyry. Calcite occnrs in irregular patches. The largest piece of gold extracted was in the form of a plate ¼ in. thick, weighing over 100 oz. Gold also occurs in much smaller masses entirely within the calcite, in small replacement veinlets, generally along the cleavage directions. The Five Pines and Surprise mines are situated about 1½ miles above the junction of Van Ness creek and Trinity river. From 1896 to 1912 the gold output was $275,000. Opposite them are the Keno and Emma prospects. The Surprise is the best developed. Pockets are fonnd on the slate and meta-andesite contract. The best pocket in this mine yielded $45,000 in a distance of 44 ft. The discussion of these pocket deposits is interesting, and should be secnred by California miners.

Siskiyou County

(Special Correspondence.)—The Rollin Mining Co. has increased its working force at the Black Bear mine, and is pre-

paring to operate more machine-drills. Good ore is showing in the bottom levels.

The old mill at the McKeen mine, near Callahan, is being equipped with cyaniding machinery, and its capacity increased to 25 tons daily. Mine developments are satisfactory, the main vein being developed several hundred feet, and showing an average width of 30 in. Three other veins have been cut, and are to be developed at once. Eighteen men are on the payroll. The McKeen was purchased last summer by J. R. McKinine and associates of Los Angeles.

The Victory Gold Mines Co. is erecting a sawmill at its property near South Russian creek, and is rapidly completing erection of the quartz mill. Crushing will probably start before the end of September.

Work is proceeding quietly at the Highland mine on Russian creek. The company is composed of Dutch people, and the property is operated along the most rigid lines of economy. John Mattern is superintendent.

Mining is active in the vicinity of White Gulch, with several important quartz discoveries reported. Near the Lanky Bob mine an ore-shoot assaying about $50 per ton has been discovered by A. J. Tellis and Bert Finley. It is about 12 in. wide, and getting wider.

The Hickey mine has good ore, and is being vigorously worked by Means & Neilon. The ore is coming from the Hickey vein which has produced well in past years.

Small shoots of good ore have been found recently in the Baldwin, Towne, and other claims.

Yreka, August 15.

Yuba County

According to J. F. Sheldon of the *Boston Financial News* No. 14 dredge of the Yuba Consolidated yielded 336 oz. of gold during a recent week. This was valued at $6300. He saw this metal melted.

The Yukon Gold Co. has acquired control of ground adjoining the Yuba Consolidated estimated to contain $4,000,000, according to drill-holes. A large dredge has been ordered, production to commence at the end of the year.

COLORADO

Fremont County

It is reported that the smelter at Florence, belonging to the Rocky Mountain Smelting Co., which has been idle for 10 years, will resume operations as a subsidiary of the U. S. S. R. & M. Co. H. H. Utley of Denver has an option on the plant.

Eagle County

Uranium and vanadium ores have recently been discovered about eight miles from Eagle, and all the surrounding area has been staked.

Lake County (Leadville)

The pumps at the Penrose shaft are again working at full capacity.——The zinc-oxide plant is producing from 30 to 40 tons per week, the company receiving good prices for the product.——The Iron-Silver company has just distributed a dividend of $50,000.——Rich zinc carbonate has been opened in the Weston Pass district by the Riach Bros. Water has prevented deeper work being done.——The 10-stamp mill at the Gordon-Tiger is nearly complete. High-grade zinc concentrate will be produced.——A large quantity of rich gold ore continues to be developed in the St. Louis adit.——The Valley adit is in 1300 ft.——The Yak company has secured a 10-year lease and $600,000 bond on the Alladin claims at the foot of the Mosquito range. The Yak tunnel may be extended to this property.——A large hoist is being installed at the Garhutt, also a 15-drill air-compressor. The output of gold ore is 200 tons per day, worth nearly $20 per ton. A 200-ton mill is being planned. John Cortellini is manager.——The Molybdenite mine is sending 1000 tons of ore to the Leadville District mill.

Ouray County

The Camp Bird company reports as follows for the second quarter of 1915: development, 668 ft.; stoping, 12,860 cu. ft.; ore broken in stopes, 15,188 tons; ore treated, 7626 tons; revenue from bullion and concentrate, $187,992; working expenses, $78,720; profit, $130,000 plus $53,000 from the Santa Gertrudis company of Mexico. It is estimated that broken ore in stopes will yield a profit of about $200,000.

San Juan County

The Silverton district shipped 45 cars of ore during the past two weeks, the largest quantity for many years. The Sunnyside mill sent a train-load of zinc concentrate. This product was made by the Huff electrostatic separators. The plant is being enlarged.——The Hamlet mill, using flotation, has been started. A. E. Ritter is manager of the mine.

Teller County (Cripple Creek)

(Special Correspondence.)—The district generally is quiet at present, but an optimistic feeling prevails. Owing to heavy rains during the past 10 days, surface work, so far as dump lessees are concerned, has been almost at a standstill. Considerable surface prospecting has recently been done on Tenderfoot hill, owing to several rich discoveries in that vicinity.——A rich development was recently made in the Hondo property, situated between the Portland and Golden Cycle properties. It is reported that the vein is more than 10 ft. wide. In the middle is a high-grade streak of smelting ore; the remainder will make a good grade of mill ore.——At the annual meeting of the Blue Flag Gold Mining Co., recently held at Denver, John F. Erisman was re-elected president.——At the annual meeting of the Modoc Mining & Milling Co., held at Pueblo, F. R. Frankenberg, Sr. who has been president and general manager since its incorporation in 1893, retired from the presidency. Wardner Williams of Pueblo was elected president.

Cripple Creek, August 20.

IDAHO

Shoshone County (Coeur d'Alene)

A new high-grade zinc shoot has been cut in the Interstate-Callahan. This is distinct from the orebody in No. 6 adit. A cross-cut from the 1200-ft. level of the Success has also opened rich zinc ore. Good shoots have recently been developed at 500, 600, and 860 ft. The August output of concentrate will be about 2000 tons, also 500 tons of lead concentrate. An 8-cent per share dividend, equal to $120,000, is probable for September. An aerial tram from mill to railway, 1300 ft., has been ordered. This will reduce transport 50c. per ton.——At 400 ft. depth in the Marsh the cross-cut is in 475 ft., and the Got-Em-Now vein should be cut in another 150 ft. The daily advance is 10 ft. The three-compartment shaft is down 900 ft. ——On September 15 the Federal company will pay $1 per share on the preferred stock, a total of $120,000. The total for 1915 will be $360,000, and $15,045,545 to date.

Antimony mining in the Pine Creek district is of importance. The Old Antimony mine is being unwatered with T. W. Faulstich in charge. Some rich ore has been shipped in the past. ——T. Brown and J. Finnel are busy opening their mine.—— In Ross gulch C. Pearson is driving 200 ft. to cut a shoot showing on the surface. Some ore has been sent to Salt Lake City. ——At the Constitution there are 18 men employed. This is a zinc mine, and ore is being shipped.

MICHIGAN

Houghton County (The Copper Country)

Fire started at a depth of 100 ft. in No. 2 shaft of the Centennial mine last week, and spread up to the shaft-house, burning the wood and motors in the steel ore-house. Oxygen helmets were used with advantage. The production will not be curtailed, as No. 1 shaft will take care of this.

A second mill test of ore from the New Arcadian was recently completed at the Franklin mill. From 841 tons the yield was 34.2 lb. per ton of mineral, against 1870 tons of 31.5

lb. ore in the first run. A great deal of this ore came from the 900-ft. level. The results are considered satisfactory.

MISSOURI

Jasper County

Production of the Missouri-Kansas-Oklahoma region in the week ended August 14 was as follows: blende, 4588; calamine, 326; and lead, 847 tons, averaging $66.48, $53.85, and $51.35 per ton respectively. The total value was $365,870.

At the What Cheer mill, at Prosperity, there are 29 motors, each driving separate machines. The plant has a capacity of 250 tons in 10 hours. Ore is mined at a depth of 185 feet.

The chief of the bureau of State mine inspection, George Hill, has been investigating mining conditions in the Joplin district. He was accompanied by Lee Burch, the local inspector. Mr. Hill found things satisfactory.

Under the direction of W. N. Squires the Franklin company's 300-ton mill north of Duenweg was erected in seven weeks. A 165-hp. Bessemer engine drives a compressor, and one of 150 hp. drives the mill. A centre-fed 350-ton hopper is a feature in the plant. Rolls are 36 and 30-in. diameter. Two 36 by 48-in. 5-cell rougher-jigs, one 6-cell cleaner-jig, and one sand-jig complete the equipment.

MONTANA

Silverbow County

The Anaconda company has started pumping at the Nettie mine, several miles west of Butte. Work was stopped last year on account of the metal market. The shaft is 450 ft. deep, connected with extensive workings. The flow is 1500 gal. of water per minute. The Nettie has been a large silver producer, but zinc has largely displaced it at depth.

The Butte & London shaft has been unwatered to 1100 feet.

NEVADA

Elko County

The Jarbidge district is active and encouraging returns are being made. The Bluster 10-stamp mill is earning between $5000 and $7000 net per month. A power-plant is to be installed, and a cyanide-plant will be added. Amalgamation is recovering about 70%. Over 40,000 tons of ore has been blocked out in the mine. An aerial tram carries ore 3400 ft. to the mill.——A small stamp-mill is to be erected at the Flaxie mine.——The Pick & Shovel company is building a plant.

Esmeralda County

A three years' lease has been secured on the Bonnie Claire company's mine and 20-stamp mill, 38 miles south of Goldfield, by the Quigley Reduction Co., headed by J. D. Quigley and others of Los Angeles. Previously the Jumho Extension company sent its ore here to be treated. The plant will treat custom ore, and motor-trucks will haul ore from mines at Gold Mountain, Tokop, Hornsilver, and other centres. One of the principal shippers to the mill will be J. W. Dunfee, who is working the Orleans mine at Hornsilver, owned by a French concern. Every four days he is at present sending 50 tons to the Belmont plant at Millers. The Quigley company has also resumed mining at the Hard Luck claims of the Bonnie Claire.

Humboldt County

Antimony ore shipments from various points in this county are estimated at $10,000 during the past two months.

A 16-hr. run at the Seven Troughs Coalition mine last week yielded $2500, four days gave $9000, and $12,000 from six days' work. The August yield is expected to be about $50,000.

The Rochester Mines Co. has purchased the Big Four lease on Block 1 of the Crown Point claim. The claim has been producing 50 tons of $25 to $30 ore daily, the total output being over $400,000. An extensive shoot is being mined from the winze between 300 and 400 ft. depth. A hoist is to be installed at the winze, which will be sunk another 300 feet.

The Lincoln Hill Mining & Milling Co.'s two-stamp mill produced $5200 in July. Four veins have ben cut in two adits.

At Willard, the new gold centre, the Willard Cousolidated has started work in two places. It has also taken over two important leased claims. Shafts are to be sunk. San Francisco people are behind the concern.

UTAH

Beaver County

The 500-ton plant to treat about 1,000,000 tons of copper tailing at the Cactus mine is expected to be ready for work in about two weeks. A flotation process is to treat the 0.75% material.

Emery County

A good deal of copper ore has been developed in the Copper Globe claims, 35 miles southeast of Ferror, a company is to be formed, and probaly a reverheratory-furnace erected. E. J. Rhodes of Eureka is largely interested.

Juab County

A new orebody in the May Day is yielding ore returning upward of $70 to $80 per ton.——The new Knight-Dern mill at Silver City is to treat the large tailing dump at the Eureka Hill mill.——The A. S. & R. Co. has nearly removed the Sioux mill dump at Mammoth to its smelter at Garfield.

Salt Lake County

The Ohio mill is treating about 2400 tons of copper ore daily, and 200 men are employed by the company. The Empire Trust Co. of New York has started suit against the Ohio Copper Co. to foreclose a mortgage given to secure $2,000,000 worth of bonds issued by the latter, and also to investigate other matters.

The Salt Lake Stock and Mining Exchange had the busiest day in years on August 18, when 136,100 shares, valued at $51,872, changed hands. The largest interest was in Alta and Cottonwood district's properties.

Great actiivity continues in the Alta district.——Ore has been cut in the Emma mine assaying 56% lead and 175 oz. silver per ton.——In the Little Cottonwood district the Wasatch Mines Co. is to start an adit to cut the orebodies at depth. It will be about 5000 ft. long.——The Secret Mining Co. is driving an adit to cut the dike and limestone-quartzite contact.

The Montana Bingham Consolidated drainage, transportation, and development tunnel is in 4000 ft. Five veins have been cut, the last assaying 3.2% copper, 31% iron, 4.92 oz. silver, and $1.20 gold per ton. Good results are expected in the next 1500 ft. of driving.

Tooele County

The Ophir Mines Development Co. has been organized to develop the old productive deposits of ex-senator W. A. Clark at Ophir. Several million dollars worth of ore has been extracted from the property. The district has yielded $20,945,000 up to 1915. Present producing companies are as follows: Ophir Hill Consolidated, Lion Hill Consolidated, Buffalo Consolidated, Hidden Treasure, Eureka Ophir, Cliff, and Mono Development.

Washington County

(Special Correspondence.)—Activity is increasing at Goldstrike. The Hays-Monette interests have concluded the purchase of the Dora Jane claims, considered among the best in the district. A contract has been awarded for development on an extensive scale. It is reliably stated that these people have secured options on several other properties.——Recently two new companies have been formed to operate in Goldstrike; the Goldstrike-Peepstone company will begin development work on its property in a few days; the Goldstrike-Virginia Mining company, has work well under way. The last named company has acquired the Wild Cat and the Silver King claims; $11 ore has been found on both these properties.

——At the Primers, under lease to the Lund Bros. of St. George, Utah, where work has been done for two months, high-grade ore has been opened where the vein was cut in a drift from the 50-ft. shaft. Ore averaging $100 per sack, is being sent to Salt Lake.——The Goldstrike Bonanza company, has found high-grade ore; several tons have been dispatched to Salt Lake City.——The Bee Bee is crushing ore that averages, according to last assays, $37.40 per ton, at the three-stamp mill at Goldstrike. Several thousand tons of this ore is already blocked out.——On the Red Bull or Evans group, where good low-grade ore has been found on the surface by prospecting, development has been started.

Goldstrike, August 7.

CANADA

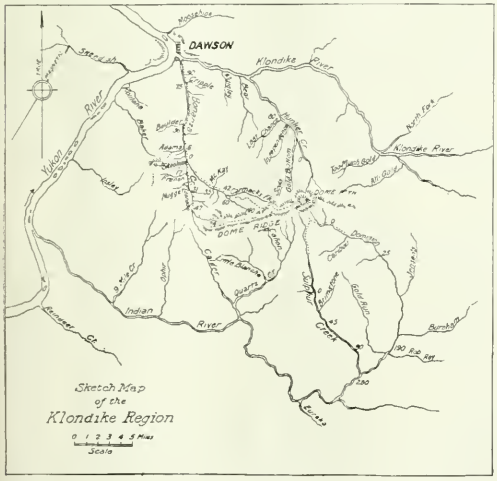
Ontario

In July the Hollinger mill treated 35,728 tons. Of this, 25,076 tons of $9.24 ore was from the Hollinger, and 10,652 tons from the Acme. The profit was $124,222. Costs were $3.73 per ton. The cross-cut at 425 ft. is only 125 ft. from the Middleton orebody.

At the Dome Lake mine $18 to $20 ore is being mined at 400 feet.

Yukon

At the end of July the Yukon Gold Co. lost by fire 3500 cords of wood worth $45,000. This was stacked on claim 45



and was being used for thawing gravel along Bonanza creek.

With 31 pages, including 11 plates and a map, Museum Bulletin No. 15, geological series 26, the Department of Mines at Ottawa issues a description of the Gay Gulch and Skookum meteorites by R. A. A. Johnston. These were found during gold-mining operations in two gulches tributary to Bonanza creek, near Dawson. The first was found in 1901 in a sluice-box on No. 6 claim, Gay gulch. It must have rested on bed-rock, or not more than 2 or 3 ft. above it. The meteorite weighed 483 grams. It had been subjected to attrition, and had no pittings as of recent falls. It contained 83.85% iron and 15.03% nickel. The Skookum was found in 1905 on claim No. 7, Skookum gulch, 3½ miles from the other meteorite. It was discovered 65 ft. below the surface, 2 to 3 ft. above bed-rock. It weighed 15.88 kilograms, and contained 80.65% iron and 18.2% nickel. A study of both points strongly to the probability that these irons are relics of a single meteoric shower which took place back in Tertiary time.

The American Electrochemical Society will meet in San Francisco during September. Seventeen papers have been accepted.

PERSONAL

Walter H. Weed is in Newfoundland.

Philip L. Foster of New York is here.

F. L. Ransome is here on his way south.

Lewis Shackleford is here from Junean.

George H. Garrey has returned to New York.

Leo Von Rosenberg was at Cripple Creek recently.

J. R. Geary is at the Clift hotel, on his return from Chicksan, Korea.

R. H. Ernest has returned to Round Mountain, Nevada, from Los Angeles.

Charles C. Selbie, of Pasadena, sailed on August 25 for the Philippine Islands.

Sanford Makeever, of New York, has been visiting the Juneau goldfield, Alaska.

George Otis Smith, Director of the U. S. Geological Survey, is due here on September 2.

R. R. Goodrich has been appointed professor of metallurgy in the University of Idaho.

John Gross has returned from Mexico and opened an office at 523 McPhee Bdg., Denver.

Alexander S. Proskey, of Rawhide, Nevada, has been spending a week at the Exposition.

Leon J. Pepperberg has returned from New York. He is going to Texas in September.

Colin Fraser has completed a geological examination of the Mt. Morgan mine, Queensland.

Robert M. Raymond, of Mexico City, and J. H. M. Shaw, of London, are at the St. Francis hotel.

W. J. Lakeland, recently with Burma Mines, in the Northern Shan States, is expected in San Francisco.

James F. McCarthy has been appointed manager for the National Copper Mining Co., at Mullan, Idaho.

G. Villaloros, director of the Panuco of San José de Gracia mines, is here from Mazatlan, Sinaloa, Mexico.

H. D. McCaskey, Chief of Mineral Resources Department, U. S. Geological Survey, is expected here next week.

F. H. Minard, who has been in Colorado and Nevada, spent a couple of days here, before returning to New York.

C. H. White, Professor of Mining and Metallurgy at Harvard, after a visit to Nevada, is returning to Boston.

Forest B. Caldwell, general manager for the Mexican Candelaria Gold Mining Co., of Durango, is in San Francisco.

H. T. Dickinson, assistant general manager to the De Beers Consolidated Mines, Ltd., is due at San Francisco from South Africa in October. His address will be care of Columbia University Club, New York.

H. D. Pallister has resigned as assistant Professor of Mining in the School of Mines of the Pennsylvania State College to become Professor of Mining and Geology in the State School of Mines, University of Texas, at El Paso.

R. P. McLaughlin, the State oil and gas supervisor, has appointed the following deputies: M. J. Kirwan in Fresno, King, counties and part of Kern county, stationed at Coalinga; E. B. Latham in Kern, Santa Barbara, and Ventura counties, headquarters at Santa Barbara; R. B. Moran in Orange, Los Angeles, and Ventura counties, with Los Angeles as head office; and Chester Naramore in charge of work in Kern and Ventura counties. The department of petroleum and gas is controlled by the California State Mining Bureau.

The American Chemical Society, California Section, will meet at Los Angeles on August 16 to 18, and at San Francisco August 25 to 28, inclusive. Papers will be read, and excursions are planned at each place.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, August 26.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	4.85— 5.80
Quicksilver (per flask)	$95
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, August 26.—The copper market is strong and excited; lead shows a tendency to panic; zinc is active, with a strong upward movement.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Aug. 19	16.25	July 14	19.50
" 20	16 25	" 21	19.04
" 21	16.12	" 28	18.62
" 22 Sunday		Aug. 4	18.27
" 23	16.00	" 11	17.94
" 24	16.00	" 18	16.88
" 25	17.00	" 25	16.27

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	....
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

The Chile Copper Co. expects its plant to be at full capacity, 10,000 tons per day, by the end of October. A drill has cut 2.11% ore at a depth of 1530 feet.

The Inspiration Consolidated company expects its plant to be at full capacity, 15,000 tons per day, by January 1, 1916. Four of the 18 units are treating 1200 tons.

In July the Miami produced 4,087,611 lb. at a cost of 8.195c. per pound. The recovery was 79.26%. This is the first month that the yield was over 4,000,000 pounds.

In its financial year the Granby Consolidated produced 26,705,928 lb. copper, 415,806 oz. silver, and 32,129 oz. gold, about 70% of which came from the Anyox property. The June yield was 2,053,027 lb. from Anyox, and 1,573,902 lb. from Grand Forks.

The Allouez is producing at the rate of 10,000,000 lb. per annum, at 9c. per pound.

From its copper output alone the Tennessee company's profit is equal to 12% dividend for the year.

On September 7 the Quincy company will pay $2 per share.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug. 19	47.12	July 14	47.56
" 20	47.37	" 21	47.47
" 21	47.12	" 28	47.29
" 22 Sunday		Aug. 4	47.08
" 23	47.12	" 11	47.27
" 24	47.00	" 18	47.33
" 25	46.75	" 25	47.08

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47 52
Feb.	57.53	48.45	Aug.	54.35	....
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec	49.27	....

The weakness in silver continues. On August 21 about 350,000 oz. was sent from San Francisco to China, also about 55,000 oz. from the Trail smelter in British Columbia. Exports from London to the Orient to August 4 totaled £4,393,500, against £2,955,000 in that period of 1914, a decrease of, say, 16,000,000 oz. Excellent rains were reported from different parts of India during the early part of August. The Punjab district has not received so much, but irrigation helps to minimize a lack of rain. The September rain is of more importance in that region. Depression in the Bombay silver market is attributed to dry weather, but the late rains are expected to result in a better demand for the metal from the Bazaars. There are 5800 bars of silver at Bombay.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July 28	95.00	Aug. 11	95.00
Aug. 4	95.00	" 18	90.00
		" 25	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60 00	Aug.	89.00	....
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38 60	90.00	Dec.	53.10	....

Quicksilver is firm at the increased quotation of $95.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Aug. 19	4.45	July 14	4.60
" 20	4.45	" 21	5.58
" 21	4.45	" 28	5.50
" 22 Sunday		Aug. 4	5.12
" 23	4.47	" 11	4.79
" 24	4.50	" 18	4.44
" 25	4 60	" 25	4.49

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	....
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Aug. 19	11.00	July 14	22.26
" 20	11.25	" 21	20.33
" 21	11.50	" 28	18.96
" 22 Sunday		Aug. 4	17 79
" 23	12.00	" 11	15.12
" 24	12.50	" 18	12.21
" 25	13.50	" 25	11.96

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.45	....
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The Canadian government is to pay a bounty on zinc refined in the Dominion, the total bounty not to exceed $400,000. A plant will be erected at the Trail, B. C., smelter, and an electric smelter at Welland, Ontario.

The Commonwealth Government of Australia has granted permission to the Amalgamated Zinc Co. to sell 50,000 tons of concentrate (about 48% metal) to the Edgar Zinc Co. at £9 11s.6d. ($45.96) per ton.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39 76	37.32	Aug.	50.20	....
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	32.51	....
June	30.72	40.26	Dec.	33.60	....

On August 25 tin was dull at 34 to 34.50 cents.

Ore producers and smelting companies will find U. S. Bureau of Mines Technical Paper 83, by Charles H. Fulton, entitled 'The Buying and Selling of Ores and Metallurgical Products' of value to them at this time of high and fluctuating metal prices.

The late president of the American Metal Co., Jacob Langeloth, who died August 14, 1914, left $5,528,413. He held shares in some of the largest metal concerns of the country.

Eastern Metal Market

New York, August 20.

The metals are lower in price, and the market is generally disappointing. The downward course of copper appears to be a further indication of the extent to which commerce is out of joint. Copper and steel are frequently said to move together, yet steel is mounting steadily to higher levels, while copper is steadily going down. The main cause of the situation, of course, is the paralysis of industry abroad, and another is the low rate of foreign exchange. In the past few days the value of the pound sterling has been down to $4.65, which makes buying here costly. Deliveries in all the metals are heavy, but new business is light. In zinc a little more life has been shown in the past few days, and the market steadied a little, but the trade is expecting the price to go below 10 cents at any time. There are some large war requirements to be covered sooner or later, but the brass-mills are supplied for the present, inasmuch as they bought heavily when contracts were booked. Lead has been inactive for the most part, but it is not expected that quotations will go much lower. Tin has been quiet without a break, and as for prices, the heavy arrivals of the month will keep them down. Aluminum maintains its strength, and therein stands alone among the metals.

Pig-iron has continued to advance in price; likewise finished and semi-finished steel. The munition plants continue to buy machinery, and the foreign demand for tools is so great that printing press manufacturers, makers of wood-working machinery, and others are now making engine-lathes. Toolbuilders generally are sold up to next year, and some until next June.

COPPER

The nominal quotation for electrolytic copper, August 20, was 16.25c. cash, New York. Reports were current that domestic consumers had taken, the day previous, 500,000 lb. at this price, but the sale was not confirmed, and reliable representatives of the trade said they doubted the propriety of giving publicity to such vague rumors. The weaker market here is largely a reflection of the state of the London market, where spot electrolytic was quoted August 19 at £80. The metal was quoted August 12 at £81, August 6 at £86 10s., and July 15 at £93 10s. In the past week second-hands have brought considerable pressure to sell; where the producers have stood with regard to price is more or less a matter of doubt. Some of them have held for 17c. cash, New York. Day after day the trade has been waiting for something to happen, just what they did not know, but nothing has transpired to break the monotonous quiet. Lake has been as dull as electrolytic, and it is rapidly approaching the latter's level. Some brands can be had at prices but a fraction above electrolytic, although prime brands are still quoted at 19 to 20c. Exports from the first of the month are unsatisfactory, as they total only 11,719 tons. They might be larger if American sellers would accept low prices, 16 to 16.12½c., for instance, but this they have so far been disinclined to do. An unquestioned influence back of the inactivity of the foreign market is the low rate of foreign exchange as before mentioned. As has been said, there are still large war order requirements to be covered, but these needs are not pressing, manufacturers having covered heavily when they booked the orders. Incidentally, with a declining market consumers are encouraged to hold off in buying. As usual, they will have to see the market going up before they will become active. Sheet copper is now quoted at 23c., base. A reduction of 1c. became effective August 19.

ZINC

For days the market has been dull to a point which properly might be called stagnant, although yesterday and today there has been some show of interest on the part of buyers, and a little better feeling. Yesterday the market was 11c., New York, and 10.75c., St. Louis. As with copper, it seems that the large makers of war munitions bought heavily when they secured their contracts. Nevertheless they must buy again, inasmuch as their war contracts have from two to three years to run. Incidentally new contracts for shells and ammunition are being placed, and others are pending. Inasmuch as the brass-mills are supposed to be filled to capacity for some time to come, it is a problem how the new demand for sheet-brass will be cared for, unless new rolling-mills are built, or old ones enlarged. Inquiries for cartridge-metal are bandied around and, seemingly, are nowhere welcome. Zinc at the present time is subject to so many counter influences that it is difficult to diagnose the market.

The very choice grades of zinc are still held at high prices, 35 to 40c. per lb., while ordinary brass-mill spelter can be had around 15c. With all the low prices, and the efforts to sell on the part of some, it remains a fact that some producers are comfortably sold up into next year. The exports August 1 to 21 total 3118 tons. Jobbers in galvanized sheets report that the demand for this product is poor; but it should improve with the lower cost of zinc and the improved demand for sheet, in turn, should help the sale of the metal. Galvanized pipe has been reduced, and likewise galvanized sheets. The latter, No. 28, is now quoted at 3.60c., mill.

LEAD

This metal is quoted at 4.45c. New York, by independents, and at 4.50c., by the leading interest, (the A. S. & R. Co.) The general opinion is that the bottom has been touched for the present. Last week the market sagged to 4.40c. New York (outside price), but since then there have been both inquiry and purchasing on the part of Russia, and a better tone has set in. Deliveries have continued at a heavy rate. The hope is that export sales will be resumed before long. The exports of the month, up to the 21st, totaled 1758 tons.

TIN

Since the buying of several hundred tons of futures, a couple of weeks ago, the market has been extremely quiet and uninteresting. There has been some interest shown in future positions which are attractive in price, the quotations of August 19 being 33c. for September and 32.65c. for October to January, but buyers are extremely slow about taking hold and definite inquiries are lacking. The quotation for spot August 19 was 33.75c. The deliveries for the month will be heavy. The arrivals up to August 21 totaled 3430 tons, and there was afloat on that day 4850 tons, most of which is scheduled to arrive in the month. London has slumped badly, and the trade there is discouraged. There is in Liverpool enough Bolivian tin ore to make over 4000 tons of refined tin. A good feature in America is an enormous demand from abroad for tin-plate. It has reached proportions which have compelled some of the mills to decline business, and is making a strong domestic market for plate.

ANTIMONY

In the past week there have been repeated efforts to sell antimony at reduced prices, but without much success. Russia is reported to have made various inquiries, but few or no sales have resulted and it is probable that that country will buy direct from China or Japan. Quotations are down to 31 to 32 cents.

ALUMINUM

Aluminum is firm at 33 to 35 cents.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz.-20s	9½
6s-12 oz.-20s	9	6s-16 oz.-40s	10
6s-14 oz.-40s	9¼	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	40
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha, iron bbl. or bulk	10
Red Crown gasoline, iron bbl. or bulk	11		

	Per bbl.
Calol fuel oil, f.o.b. Richmond Refinery	$0.80

	Per ton.
Petrolastic cement X	$13.00
Petrolastic cement XX	12.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked* subject immediate delivery.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	*$65.00	$90.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.12	0.15
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	50.00	60.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	12.00	15.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	50.00	55.00
Snowball, per M	40.00	45.00
Flint pebbles for tube-mills, Danish, per 2240 lb	21.00	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	35.00	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	450.00	600.00
Tungsten ore, 65%	*450.00	540.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	subject negotiation	

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb.	$ 0.80	$ 1.10
Acid, sulphuric, com'l, 66°, carboy, per 100 lb.	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb.	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb.	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb.	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb.	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb.	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb.	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb.	4.75	5.63
Borax, powdered, bbl., per 100 lb.	5.25	6.10
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	11.50	14.50
Bone ash, 60 to 80 mesh, bbl., per 100 lb.	0.50	6.50
Bromine, 1-lb. bottle, per lb.	0.55	0.65
Clay, domestic fire, sack, per 100 lb.	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb.	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb.	"	"
Cyanide, 129%, 100-lb. case, per lb.	"	"
Cyanide, 129%, 200-lb. case, per lb.	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.75	12.50
Lead acetate, white broken, casks, per 100 lb.	10.87	13.50
Lead acetate, white, crystals, per 100 lb.	12.50	13.25
Lead, C. P., test., gran., per 100 lb.	13.00	15.00
Lead, C. P., sheet, per 100 lb.	15.00	18.00
Litharge, com'l, per 100 lb.	8.75	9.25
Litharge, C. P., silver free, per 100 lb.	13.00	15.00
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	90.00	115.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	15.00	16.00
Nitre, double ref'd., granular, bbl., per 100 lb.	16.00	17.00
Nitre, double ref'd., powdered, bbl., per 100 lb.	16.00	17.00
Potassium bicarbonate, cryst., per 100 lb.	22.00	25.00
Potassium carbonate, calcined, per 100 lb.	30.00	40.00
Potassium permanganate, drum, per lb.	1.10	1.25
Silica, powdered, bags, per lb.	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb.	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb.	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb.	5.25	....
Soda, caustic, solid, 98%, drums, per 100 lb.	5.00	....
Zinc shavings, 850 fine, bbl., per 100 lb.	34.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb.	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

In its circular of August 12, the Roessler & Hasslacher Chemical Co. of New York states that there has been no change in the general situation and market conditions continue to grow firmer. Owing to further scarcity of some chemicals, or higher prices of their raw materials, there have been advances in prices. No quotations are given in the list for cresol, manganese compounds, oxalic acid, peroxide of hydrogen, platinum products, potassium compounds, or zinc-dust. Sodium cyanide, 51-52% cyanogen, is 26c. per pound, and cyanide mixtures, 39.5% cyanogen, is 29c. per pound.

Fuming sulphuric acid has advanced about 100% in price recently. There is a great demand for it, especially from Europe.

COMPANY REPORTS

MT. MORGAN GOLD MINING COMPANY, LTD.

Report No. 58 of this Australian company covers the year ended May 30, 1915, although the acting general manager's (A. A. Boyd) report deals with the second half. In the six months the following resulted:

Development, feet	1,999
Ore reserves, tons	2,847,197
Ore smelted, tons (2.73% copper, $8.07 gold)	119,478
Ore concentrated, tons (2.14% copper, $4.92 gold)	57,974
All products smelted, tons (including Many Peaks pyrite)	154,737
Copper production, pounds	12,503,680
Gold production, ounces	69,280
For the year:	
Ore smelted and concentrated, etc., tons	423,924
Copper production, pounds	20,278,500
Gold production, ounces	116,505
Total income	$4,802,500
Net profit	802,000
Dividends	480,000
Surplus (including amount brought forward from 1913)	893,000
Excess of assets	$2,210,000

BUTTE & SUPERIOR COPPER COMPANY

The Butte & Superior Copper Co. reports as follows for the second quarter of the current year:

	Second quarter.	First quarter.
Ore milled, dry tons	124,080	117,860
Average zinc-content, per cent	17.003	17.3560
Average silver-content, ounces per ton.	8.067	7.9502
Zinc concentrate produced, tons	35,840	35,317
Average zinc in concentrate, per cent.	52.706	52.9246
Zinc in concentrate, pounds	37,780,020	37,382,742
Silver in concentrate, ounces per ton.	22.714	22.6488
Mill recovery, per cent	89.536	91.3190
Mining cost per ton	$3.3816	$3.0005
Milling cost per ton	1.8108	1.8659
Total cost per ton	$5.1924	$4.8664
Net value of zinc concentrate at mill	$2,509,229	$1,792,434
Net value of lead concentrate at mill, and of residue	230,293	212,357
Miscellaneous income	11,899	6,719
Total net value	$2,751,423	$2,011,510
Operating charge	644,270	848,354
Profits	$2,107,153	$1,163,156

Operating costs in the first quarter include freight on concentrates and residues, which in the second quarter are deducted from value of these products.

The stated profits for the second quarter were calculated on a basis of spelter prices of 10.364c. per pound for April, 12.106c. for May, and 15.961c. for June, an average of 12.683c. for the three months, this price being somewhat lower than the average actually received for zinc sold during the quarter.

Ore treated was the largest in any previous quarter. The grade was below normal, the idea being to mine some lower-grade material when prices are high. The lower recovery is partly due to this, and partly to the new flotation plant. Development at the mine continued to open as much ore as that extracted. The report also dealt briefly with the smelting contract.

INTERSTATE-CALLAHAN CONSOLIDATED MINES COMPANY

During the second quarter of 1915 the Interstate-Callahan Consolidated Mines Co., Idaho, made the following production:

Ore mined, tons	30,595
Ore shipped to smelters, tons (44.6% lead, 21.05 oz. silver)	68
Ore shipped to smelters, tons (49.74% zinc)	2,834
Ore milled, tons (27.8% zinc)	27,235
Concentrate produced:	
Lead, tons (59.49% lead, 26.72 oz. silver)	851
Zinc, tons (48.24% zinc)	11,399
Mill recovery, per cent	78.28
Cost per ton:	
Mining	$3.070
Milling	0.672
Transport, etc.	1.267
Total	$5.009
Profit	$1,126,114

Up to August 2, dividends for the year total $1,610,000. Including the next two quarters the amount will be $1,840,000, while an extra of $2 per share will make a total of $2,760,000.

MINING DECISIONS

Severance of Minerals—Injury to Surface

Where the land owner has granted the surface by deed and reserved the minerals without any covenant for surface support, the surface owner cannot recover for injury to the surface on the theory of an implied covenant for surface support, but must show negligence in mining methods employed by the owners of the mineral rights in order to recover damages.

Kirwin *v.* Delaware L. & W. R. Co. (Pennsylvania), 94 Atlantic, 468. April 12, 1915.

Oil and Gas Lease—Suit to Forfeit—Parties—Rentals

In a suit by an assignee of any ordinary oil and gas lease, brought to quiet his title and enjoin the lessors from executing a second lease on the same land, it is not necessary to make the assignor a party, if it appears that the assignment is absolute and unconditional. A clause in said lease providing for forfeiture without notice upon "failure to complete a well upon the premises within the time herein specified or to pay the rentals at the time and in the manner herein provided." Held, to relate only to rentals provided to be paid for delay in drilling, and not to rentals or royalties to be paid a producing gas well.

Castle Brook Carbon Black Co. *v.* Ferrell (West Virginia), 85 Southeastern, 544. May 25, 1915.

Patent Improvements—Surveyor's Certificate

The certificate of a surveyor-general as to the requisite improvements upon or for the benefit of a lode-mining claim, made by the applicant or his grantors, is required whether the applicant be one who is relying upon an application under Section 2325, Revised Statutes, or one who seeks patent as a successful litigant in an adverse suit. Paragraph 49, of the mining regulations of March 29, 1909, is amended so as to authorize surveyors-general to accept corroborated affidavits as the basis for certificates that the improvements returned by mineral surveyors were made by the mining claimants or their grantors for the benefit of the claims surveyed, it being manifestly impracticable in many cases for the mineral surveyors to determine by inspection who made the improvements.

Archie McCormick (Land Department), 43 Land Decisions, 499. December 16, 1914.

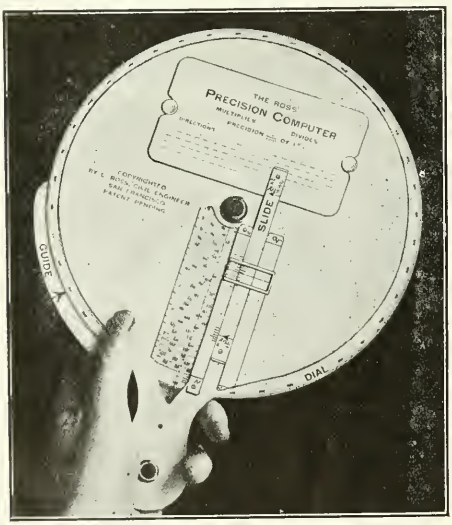
New Machines and Devices

Information based on letters and catalogues from manufacturers.

New 5-Place Computer

A new instrument, called the Precision computer, has recently been devised and placed on the market. It is compact, simple, inexpensive, and gives an accuracy equivalent to that of a slide-rule 100 ft. long. It is claimed that it combines the accuracy of 5-place, interpolated logarithms with the speed and convenience of a slide-rule, without the drawbacks of either. It solves expressions like $879.65 + 74.769 \times 72.638 = 854.58$, with an ultimate accuracy of 1/1000 of 1%, or 1 in 100,000.

The variable graduations of the ordinary slide-rule have been dropped completely. In this computer the system of graduations is absolutely uniform throughout, and is as simple as that of a 10 to the inch scale. The length of scale is 120 times



THE ROSS PRECISION COMPUTER.

as great as that of the A and B scales in the ordinary 10-in. slide-rule, although the computer is but 8-in. diameter. The accuracy of engineering data seldom exceeds 5 figures, and precise engineering computations are therefore ordinarily carried logarithmically to 5 places. The computer has been devised to give this accuracy and to combine in the same instrument means for obtaining instant, approximate results, where desired.

The computer, invented by Louis Ross, 268 Market street, San Francisco, consists of a graduated dial rotating under a slotted cover, a floating guide, and a slide mounted at the right of the slot. The dial carries a scale of numbers reading to 5 significant figures throughout, like 24364, 67342, 99893. The slide carries a miniature of the dial-scale, reading to 3 figures, and co-operates with the dial, checks and points out the precise answer, and locates its decimal point. For instant approximate results the slide alone may be used, much more directly and simply than the ordinary slide-rule.

To multiply and divide any series of numbers, it is only necessary to turn the dial so as to set each number in succession under the reading line in the slot; the answer will then appear also under the slot-line. Each turn of dial alone multiplies; of guide and dial together, divides. When data is now set on slide, one of its arrows points to the precise answer under the slot-line, gives its approximate value for a check, and by its marking, "sum, sum-1," etc., locates the decimal point in the answer.

At the left of the slot is a scale of equal parts; it co-operates with a similar scale at the rim of dial to give directly 5-place logarithms and anti-logarithms, much faster than logarithmic tables. This obviates fingering pages of tables, mental interpolations, errors, and forms, in fact, a complete table of 5-place interpolated logarithms. Powers, roots, and other complex operations may be carried out either approximately by the use of the slide alone, or to a high degree of precision by using the dial. Trigonometric calculations made by the computer give an accuracy of from 3 to 5 seconds of arc.

The computer is made of metal throughout; the graduations are engraved on silvered-metal surfaces, like a surveyor's compass or transit. It is slightly over 8-in. diameter, and weighs less than a pound. The instrument is packed securely in a flexible case, and forms a permanent, portable, and inexpensive precision computer. It is made by the Computer Manufacturing Co., 25 California street, San Francisco.

Scientific Instruments at the Exposition

Three grand prizes have been awarded the Keuffel & Esser Co. of New York and San Francisco, by the Panama-Pacific Exposition, for drawing materials and slide-rules, surveying instruments, and telescopic sights and periscopes. The exhibit in the Palace of Liberal Arts includes every requirement of the engineer for field or office work, among which are the following: the K. & E. stadia-circle, new types of slide-rules (including the chemists' duplex, Allen friction head, surveyors', Roylance electrical, K. & E. power computing, and merchants'), a display of drafting-room furniture, naval and nautical instruments, and a testing laboratory in which are shown tests necessary to insure the quality and accuracy of K. & E. products. The firm states that most of the engineering instruments used during construction of the Panama Canal were supplied by it.

Hydraulic Giants at the Exposition

At the model gravel mine in the California State Mining Bureau exhibit, in the Palace of Mines and Machinery, are several miniature giants in operation. Nearby is a full-size Joshua Hendy Iron Works, San Francisco, No. 5 latest improved, double-jointed, ball-bearing, hydraulic giant, fitted with patented Smith-LaGrange deflectors, such as are in use at the LaGrange mine in Trinity county, California. The giant has a 13-in. inlet, and is capable of taking any size nozzle up to 8-in. diameter. The giant is fitted with guide-vanes, which prevent the scattering of the water after it has issued from the nozzle, and cause it to be discharged in a more direct line. This is the type of giant which is in use in all of the hydraulic mines in the West and in Alaska, and is the same as was used at the Panama Canal.

The August issue of *Western Electric News*, of the Western Electric Co., New York, contains full particulars of the death of 468 of its Hawthorne employees, caused by the overturning of the steamer *Eastland* at Chicago on July 24.

EDITORIAL

T. A. RICKARD - Editor

THE American Institute of Mining Engineers meets in San Francisco from Thursday, the 16th inst. to Saturday, the 18th, inclusive. The American Mining Congress is called for the week following.

OUR friend, *The Mining News*, in London, states that the men working on tungsten mines in Cornwall are exempt from military service, the demand for the metal being urgent for the making of tool-steel.

UNDOUBTEDLY the War is causing hidden stores of gold to be brought into circulation. The peasantry of Europe has not learned to use safe deposits, the old stocking or its equivalent is still a receptacle for the hoard set aside for a rainy day, and now that their country is in danger, the patriotic people are bringing their gold to the bank to invest it in war loans.

HOLMES is to be commemorated fittingly by the creation of a professorship of Safety and Efficiency Engineering in the Colorado School of Mines. The professorship will bear his name and the purpose of it will be to train the students in the use of life-saving apparatus, the prevention of accidents, sanitation, ventilation, over-winding, defective wiring, the mitigation of gas and dust, and kindred subjects. The appointment has not been made as yet.

ACCORDING to *The Mining Magazine*, the rights to the Elmore flotation patents have been sold to the group of copper companies that refuses to pay royalty to the Minerals Separation company. It will be recalled that while the last decision, in March 1914, was against the Elmores as regards their bulk-oil patents of 1898 and 1901, it did not refer to their vacuum process of 1904, which antedated the basic patent (U. S. 835,120, May 29, 1905) of Minerals Separation. Presumably the purchase of the Elmore rights is to serve as munition in the campaign of litigation, by connecting the generation of air-bubbles with the production of froth, but as to this we are not informed.

CABLE dispatches state that a British syndicate has acquired control of the Swansea Vale zinc smelter, in South Wales, with the intention of increasing its capacity from 5000 to 25,000 tons of spelter per annum. This plant heretofore has been controlled by Aron Hirsch & Sohn of Halberstadt, Germany; we presume therefore that the transfer was made by consent of the British government, possibly with a guarantee of indemnity to the German owners at the close of the War, for actual payment at the present time would be prohibited by statute. We note that the new owners expect to obtain their crude ore from Burma, from which it is safe to infer that the Burma Corporation, with big zinc-lead-silver mines in the Northern Shan States, and the Zinc Corporation, controlling the South Blocks and Barrier South mines at Broken Hill, are behind the enterprise. That means Messrs. H. C. Hoover, F. A. Govett, and their associates.

WE publish a press item giving a list of increases in domestic spelter production. It is proper to add that Mr. E. V. Lanyon, of Pittsburg, Kansas, writes to say that he is adding 448 retorts only, not 1200; that the Pittsburg Zinc Co. is working to full capacity, namely 910 retorts; the Cherokee Smelting Co. is adding 224 retorts to the 672 now in operation; the Nevada Zinc Co. is building three blocks of furnaces containing 672 retorts in all, of which only one block of 224 retorts is likely to be put in operation within the next 30 to 60 days. Mr. Lanyon considers the estimate of future production much too high, mentioning unsettled labor conditions as a deterrent factor.

VAN H. MANNING has been appointed Director of the U. S. Bureau of Mines in succession to his late chief, J. A. Holmes, whom he had supported so loyally and efficiently during the latter's year of fatal illness. This appointment, by the President, will give general satisfaction, for it ensures continuity of policy and the minimum of disarrangement in the administration of the Bureau. It has been said, quite properly, that Mr. Manning is not a specialist in technology, only a capable executive. As to that, he is better equipped in one respect than in the other, but he is also a man of particular modesty, and we feel sure therefore that he will see that in his assistants he has the men that will supplement his own knowledge and experience.

ANTIMONY is in demand by the belligerents for giving brittleness, and therefore high explosive power, to the bullets in shrapnel. Hence a great scramble for the ore in the localities where it is known to occur. The old San Emidio mine in Kern county has been re-opened by San Francisco capitalists. A new mine of antimony sulphide, stibnite, has been developed in Wild Rose canyon, in the Ballarat district of San Bernardino county, and the ore is being transported on motor-trucks, of 3-ton capacity, over the 32 miles to the smelter at San Pedro, the port of Los Angeles. As much as 20 tons of high-grade ore is being taken daily out of two mines that are being worked under lease. Some of this ore is said

to run as high as 80% metal, suggesting that some of it is in oxidized form. The old Chapman smelter on Seventh and Hooper streets, in this city, is now busy, twenty small furnaces being at work. Mr. C. Solomon, Jr., a dealer in Japanese goods and hardware, is the controlling owner of this useful little smelter. He brought a large shipment of antimonial ore from Alaska and from Atlin, British Columbia, and he is getting ore from the mine at Lovelock, Nevada. He is also buying custom ore at $5 per unit, which suggests a good market somewhere in Europe.

DEMORALIZATION of foreign exchange has gone to a stage causing serious anxiety. The explanation is due to the fact that Europe's holding of gold has been hypotheeated against a disproportionate amount of paper currency and credit, while the store of gold in this country has not only grown but against it there has been issued a disproportionately small amount of currency and credit. At the beginning of the War the pound sterling was worth $7 because an exodus of gold was threatened; now the tide has turned to a disconcerting degree, the pound being worth, at the time of this writing, only $4.50. In order to restore exchange it is necessary either to import goods from Europe or buy European stocks and bonds. The continued payment for munitions and food supplies in drafts will intensify the disparity and the abnormality of exchange.

REPRESENTATIVES of the four principal engineering societies have been in conference with a view to mobilizing the engineering profession as a reserve for the engineer corps of the regular army. The chairman of the special committee appointed for this purpose is Mr. William Barclay Parsons, representing the American Society of Civil Engineers; he is co-operating with Dr. Henry S. Drinker, the president of Lehigh University, representing the American Institute of Mining Engineers, Mr. W. H. Riley of the American Society of Mechanical Engineers, Mr. Bion J. Arnold of the American Institute of Electrical Engineers, and Mr. Ralph D. Mershon of the Institute of Consulting Engineers. It is estimated that 30,000 men can be rendered available for this useful service, the details of which are being worked out in the War Department, previous to introducing a bill before Congress authorizing the formation of this engineer reserve corps.

FIVE HUNDRED million dollars, it is reported, is to be added to this country's swelling store of gold by further shipments of bullion from London to New York. Last year the world's production was $460,000,000. Of this, 63% was produced in the British dominions, 21% in the United States, and 6% in Russia. The Austro-German territories contributed 1% only. The world's stock of gold, in banks, public treasuries, and in circulation at the outbreak of the European war was estimated at $8,800,000,000, of which 80% was held within the belligerent countries, their colonies, and the United States. The Teutonic allies possessed $1,280,000,000, the British empire $1,500,000,000, the United States $1,871,000,000, while France and Russia were credited with a little over $1,000,000,000 each. Including Italy, the Allies held $3,941,000,000. During the year of war the visible supply of gold in Great Britain has increased $256,000,000, which is no more than the actual output of the mines tributary to the London market. It has been stated by *The Annalist*, for example, to which we are indebted for most of our figures, that the premium on gold has stimulated production, notably in South Africa; but this is incorrect, for no sign of increased productivity is to be observed. In 1914 the Transvaal yielded $172,602,160, as against $181,258,800 in 1913. During the first six months of 1915 the output has been $90,812,370. In July, it is true, the yield rose to $15,870,450, which is the largest since May 1913, but the increase is attributable not to the effect of any premium on gold but to the larger supply of labor, due to the idleness of the diamond mines. On the contrary, the absence of marked change in the world's gold output is the most notable fact. Owing to the geographic distribution of the principal districts, all of which are outside the war area, and the reduction of the ore at the mines or near them, together with the availability of the necessary supplies, this fundamental industry has suffered but little, except in Mexico. It is quite probable that in the wreck of international credit and the adjustment of debts at the close of the War, the production of gold will prove of immense importance.

Air-Blasts

Earth-tremors in the deep mines have again been the subject of discussion at Johannesburg, on the initiative of that free-lance, Mr. E. J. Moynihan. These sudden subsidences are due to the increasing weight of unsupported rock overhanging the mine-workings along the lode, or to the fact that, as Mr. Moynihan put it picturesquely, "the mining houses have made a tunnel in the earth, roughly speaking, thirty miles long and a few feet high. They have been widening this tunnel for over twenty years, until, on the average, it is something like a mile wide. The tunnel is also inclined in the direction of its width. Well, the roof is falling in. That is all." The diagnosis is correct: a large area of lode, dipping flatly, has been excavated, leaving a block of rock inadequately supported. At intervals and in places the pressure accumulates so as to cause a sudden collapse. That means a fall of ground, a sudden concussion of air, and the passage of vibrations that perturb those resident on the adjoining surface. Sand, the discard from the stamp-mills, has been used for filling the voids made by stoping, but this has mitigated, not stopped, the tremors or the caving that causes them. Apparently the compressibility of sand under pressure has been under-estimated, so that the filling has proved less effective than had been expected. Mr. Moynihan suggests filling the stopes with coarse rock, leaving large interstices, and

then introducing coarse-grained material, finally injecting sand to make the filling compact. In the Modderfontein B mine packs of waste-rock occupy 18% of the ground stoped; these packs are carefully built and are highly commended by the Government Mining Engineer. They, like the sand-filling, allow of a slow settling of the weight and are better therefore than pillars of unworked ground, which, as the pressure increases, eventually yield with a suddenness that is catastrophic, producing all the undesirable effects associated with tremors. The subject is one of general interest, for it concerns all deep and inclined mine-workings. In the Lake Superior copper region 'air-blasts' are as common as earthquakes in Japan; also in the deep mines of the Kolar goldfield, in India, where the sudden relief of pressure causes the detachment of pieces of rock with explosive violence. Obviously, a comparison of notes would be of service. Perhaps the principal companies operating in the three districts mentioned could come together for the purpose of appointing a commission, to which each would appoint one member, for the study of the subject and the obtaining of guidance as to the best way of meeting the difficulties inherent in the deep mining of inclined lodes.

Flotation at Broken Hill

In this issue we reproduce the major portion of an interesting paper contributed nearly two years ago to the Australasian Institute of Mining Engineers by Mr. James Hebbard, the manager of the Central Mine at Broken Hill. In this paper we are told how the zinc-lead slime obtained in the course of ordinary water concentration was treated, at first experimentally and then on a big scale, by flotation. This would be interesting in itself as coming from an engineer of high repute and long experience, but the more significant part of the paper is the information concerning the development of the process in the mill and the radical change from one phase of flotation to another. In the course of ordinary water concentration, it had been noticed that a 'froth' was formed wherever rotation, splashing, or agitation caused an entrainment or entanglement of air in the liquid pulp. This was before 1901; in that year a series of experiments was started for the purpose of "reproducing and accentuating" the conditions favorable to this froth-formation and float-concentration. Spitzkasten constituted the type of apparatus and compressed air the agent chiefly used. In this way Mr. Hebbard and his staff produced a mineral-bearing froth that was recovered as a low-grade concentrate. This is interesting because it was in 1901. Other experiments followed, including the use, in 1903, of sulphuric acid and salt-cake, after the manner of the Delprat process, which had been patented in 1902. Probably these experiments were based on information of work being done elsewhere in the Broken Hill district. Most people appear to consider that patents, like customs duties, can be disregarded without imperiling their hopes of heaven. These experiments were influenced by the large proportion of carbonates—those of lime, manganese, and lead—in the ore, which, by addition of acid, gave a plentiful liberation of carbonic acid gas. The generation of gas was hastened by the further application of direct heat under the pan in which the operation was conducted or by the introduction of live steam into the storage-tank. No agitation was used in these experiments, for a still surface was found most favorable to the maximum play of surface tension. Mr. Hebbard says that the surface tension was increased by the salts introduced, but, we venture to suggest that the opposite was the fact. However, the general result was unsatisfactory, especially as regards the separation of the finer particles of gangue from those of the metallic constituents of the ore. Apparently just at the time when this conclusion had been reached by the gentlemen at the Central mine, they received information that an important discovery had been made in London, so they awaited particulars of the new development in flotation. This discovery proved to be the so-called Cattermole or granulation or coagulation process, involving the use of soap as an emulsifying agent and the agglomeration of the flocculent oily masses that resulted therefrom. These collected the metallic particles, not to float them, but to sink them, while the gangue ascended in an up-current of water. In short, flotation was reversed. A model plant was erected at the Central mine early in 1904, and, good experimental results ensuing, a large mill was built during 1905. The details given by Mr. Hebbard are interesting, both as to the design of the plant and the method of procedure. Oleic acid, or 'red oil,' was found best and the cost of it was gradually decreased by diminishing the quantity employed from 3.5 to 0.75%. When using the smaller quantity, plus aeration, the results were excellent, "with all float concentrate, no granular material being formed." But this was no longer the Cattermole process; Mr. Hebbard was making the concentrate float, not sink; and he was not 'granulating.' We look in vain for the word 'froth' to appear. He made 'froth' in the water-concentration mill when treating the same pulp, why does not the addition of an oily emulsion, together with agitation and aeration, give him a froth that will do the work of concentration? We repeat, he got a "float concentrate" without "granular material." The temperature was raised, by the use of steam jets, in September 1905. But the official recognition of the frothing process was delayed until another 'discovery' was made, "strangely enough," says Mr. Hebbard, "at the same time both here [Broken Hill] and in the Patent Co.'s [Minerals Separation Ltd.] laboratory in London." Indeed it is strange, for Mr. Hebbard's description indicates that he had been reducing the percentage of oil, agitating, aerating, and warming his pulp-liquor until a froth was inevitable. However, we are informed that a report from Mr. A. H. Higgins was received at Broken Hill; this described the discovery made in March 1905, indicating that a decrease in oil tended to increase the float-concentrate to a point where it became advisable to reverse the Cattermole process and go back to earlier

methods of flotation, that is, buoying the metallic particles upward while encouraging the earthy particles to sink. The reduction in oil now yielded not 'granules' but a 'mineral froth.' Thus the latest phase of flotation was developed or discovered concurrently at Broken Hill and London. The result was the celebrated patent (U. S. No. 835,120, May 29, 1905) of Messrs. Sulman, Picard, and Ballot, on which the property rights of Minerals Separation are mainly based. As regards the Central mine and Mr. Hebbard, the frothing method was introduced into the mill in July 1905 and the plant was gradually adapted to the new change of procedure, so that in October flotation with simple spitz-boxes was fully established. The amount of acid apparently was so decreased that, after the second agitation, the liquor in circuit became neutral, allowing the use of iron apparatus wherever desired. Grinding-pans were found to give a product better than that from ball-mills. It would be interesting to learn whether later experience has confirmed this conclusion. Two froth-flotation plants were built. Mr. Hebbard says that during the operation of the first it was recognized that aeration was "the chief factor in flotation." This conclusion is entirely in accord with evidence obtainable elsewhere. So is his inference that the air used in making froth must be finely divided. In October 1912 Mr. Hebbard himself obtained a patent for an apparatus of staggered spitzkasten. Finally, he had the satisfaction of achieving a high extraction, namely, over 90% of the three metals: silver, lead, and zinc. Apart from the record of the steps by which he reached this result, the article is highly interesting as a record of the manner in which froth became recognized as a prime metallurgical agent.

Dull Advertisements

We believe our readers like to read articles based upon unconventional opinions; that is why we publish an occasional contribution sent to use with a 'dare,' such as that on advertising appearing on another page of this issue. However, as we give publicity to the article, we must also disavow anything like an agreement with all the views expressed by our versatile correspondent. We agree with him that a discussion of the subject needs no apology. Advertising is a matter of general interest to our readers, of course; that is what supports our periodical; it is a medium of publicity to the manufacturer of machinery and supplies; the latter finds it an effective medium because it is read by the very people whom he wants to reach, namely, the men who have the say in the purchase of machinery and supplies. By reason of this fact, the editorial department is able to furnish a lot of useful reading matter at a price far below the actual cost. So much for that. Yes, "articles on advertising are intolerably dull," mainly because they are insincere. They appear to be written for the delectation of advertising agents and solicitors instead of being prepared to arouse the interest of the consumer. Undoubtedly the bald statement that an article or machine is the best of its kind and the only pebble on the beach does not impress a thoughtful man. Mere assertions, even if shouted loudly, as by a street-peddler, do not carry conviction. For that reason we wonder sometimes why manufacturers do not give a clear description of their machine in one advertisement, following it, for example, with a letter from the manager of a mine stating that he had found the machine efficient. It is not always easy to get permission to publish such letters, but certainly they are more convincing than the manufacturers' opinion of his own product, and we may suggest that managers should be willing to do this, not as a favor to the manufacturer only but as a service to the public, particularly other managers of mines, to whom the opinion of an independent engineer is of more value than a dozen unsupported claims. As to where and how "the average mining man" first hears of a tool or machine, we venture to suggest that while our nomadic correspondent may get such information by word of mouth, it is not possible for those less migratory to keep in touch with the progress of the art except by reading the technical papers, the particular function of which is to give this kind of information, first, by the advertisement of the maker of the tool or machine and, second, by the record of its use and usefulness in writings describing current technical practice, written by superintendents, engineers, and others able and willing to give disinterested and reliable information on the subject. The "average mining man" may rise very early and remain unusually wide-awake for a period far in excess of union hours without hearing of the successful introduction of a new tool at Dan or a new machine at Beersheba. Yes, "mining men read the advertising pages" of this journal, otherwise it would cease to exist. It may be true—we think it is—that some advertising matter is so trite as to lose in effectiveness. More effort should be made to give information on the particular points that present themselves to the user of a machine; we know that some of our advertisers appreciate this requirement, for they give the data demanded; but, on the whole, we second our correspondent's 'kick' and venture to suggest that it would be well for the manufacturer to keep in mind the kind of man he is aiming to impress—a man as keen as himself. That applies also to the writers of technical papers. It is well to imagine oneself addressing an individual, typical of the class of man whose interest it is expected to awaken. Advertisements, like articles, should be written not for the people whom the sophomore that mixed his Greek and Latin called the 'hoi populoi,' but they should be written, like a letter, to a real thing of flesh and blood, brains and memory. If any of our readers care to send us comments on the advertising pages, we shall be glad to have them, in order to transmit judicious suggestions to our business supporters, the manufacturers that advertise with us. In short, we want to make the paper useful to the maker and to the user of machinery. If we do that, we shall have ample scope for discussing conduct, ethics, and the higher mathematics.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

The Carat

The Editor:

Sir—I noticed in your issue of March 27, page 488, that you state the weight of a carat as being equal to 3.166 grains. This was the equivalent of the English carat, but an international convention has adopted the metric carat of 200 mg. on account of the diversity of carats previously employed. I understand that the equivalent in Holland was 3 grains, in England 3.166, in France 3.18, and U. S. A. 3.2, but even greater diversity existed in the past and it is now practically impossible to ascertain what was the original weight of many of the historical gems.

The standardizing of the carat was a much-needed reform. The new unit only varies from the older ones by a small percentage, being almost exactly 2.5% more than the Dutch and the same amount less than the English standards, while at the same time it is instantly convertible to the metric system (5 carats = 1 gram). No doubt the abolition of the carat would have been a greater reform, but standardization is the next best thing.

FRANK ROWLEY.

Rosebery, Tasmania, July 10.

[The British standard was 205.304 milligrams or 3.1683 grains, that is, 151½ carats to the ounce troy. It is supposed that the 'carat' was derived from the weight of a hard leguminous seed. The Greek name was *keration* and the Latin *siliqua*. The seed of the locust-bean or *ceratonia siliqua* was found, by L. J. Spencer, to weigh 0.197 grams or 3.04 grains.—EDITOR.]

Efficiency Engineering in Mines

The Editor:

Sir—It is with considerable hesitation that I reply to the letter of R. E. Cranston and W. H. Shockley in the PRESS of August 7. The analysis of efficiency engineering in its effect on miners, with any attempt to generalize, is liable to be not only invidous and insipid, but nonsensical. In the same issue of the PRESS, A. E. Jacobs, of Kalgoorlie, Western Australia, demurs to the practice of comparing operating costs of different mines on the assumption that the factors relating to cost at various properties are standardized. To a still greater degree is there objection to generalize as to what miners are liable to do when efficiency rules are imposed upon them. All workmen, but particularly miners, are 'queer.' They act as much according to unreason as reason; they are suspicious, short-sighted, conservative, unjust, paradoxical, and yet they will work hard and long and cheap for a superintendent who handles them in a way they understand and admire. In a certain mining district in New York state the men worked for years with great satisfaction to all concerned under the supervision of a general manager who appealed to them by what he *didn't* do. When the company changed managers it found no end of trouble. The manager who got the excellent results didn't paternalize, efficiencyize, or any other kind of 'ize, nor did he meddle with prohibition or mushy 'reforms.' What he did was to set the men an example of working and minding his own business, getting results consistently. A certain amount of inarticulate admiration of the 'old man,' particularly as to his know-how ability in times of stress when things looked dark, was not entirely absent among the workers; and sentimental as this consideration may appear, it meant dividends and success to the company. The men would work for the manager they liked, in water, over-time, and with a supreme disregard for discomforts, where they wouldn't work at all for anyone else. Now, under what rule of Taylorism is this case classified?

I can imagine the snort some American mine-superintendents would give if confronted with the custom prevalent among the thousand iron miners on Bell Island, Newfoundland, of stopping work at quarter-shift to boil and drink a 'mug-up' of tea. And I can imagine the thousands of dollars they would undoubtedly lose the company when they attempted to do away with 'mug-up.' Owing to local peculiarities, the character of scattered underground workings, the general contrariness of human nature, and some things impossible to classify, there is usually a certain way of handling any particular community of workmen in which to get the most out of them with a minimum of bad results such as strikes, disorganization, and 'soldiering.'

It is a typically modern fallacy to believe that raising a workman's pay will invariably insure more energy put in the work, better loyalty, and greater efficiency. Sometimes it will; other times it has the opposite effect. It is also a trend of the times, more especially by kind-hearted but muddle-headed busybodies, to suppose that workmen appreciate 'welfare work' and such rot. Naturally, opinions on labor questions are only opinions, since much difference of outlook exists, but it appears to me that any interest miners seem to manifest in the introduction of systems under a bureaucracy, or existing in 'model towns,' is only due to the novelty of the thing.

At one mine in Michigan where attempts at Taylorism were made, the superintendent lost some very able foremen, shift-bosses, and miners, by his activities at 'spying' on the men. He listened over the mine-telephone, appeared underground at 3 o'clock in the morning, and generally sneaked around the place. The men said there was no satisfaction in working for him, and an unprejudiced outsider would probably agree with them.

I remember a mechanic at an exploration in the swamps of Minnesota who went down under hot water in a mine-sump to repair a drowned pump where steam had been leaking but pumping had stopped. He worked in the hot water and mud for hours because the engineer-in-charge called him 'master-mechanic.' There was an excellent miner working at an exploration near Iron River, Michigan, who quit the job because the superintendent told him to shovel instead of drill (practice on the Michigan iron ranges is to have the trammers do the shoveling, unlike the Mesabi custom where miners do their own shoveling). These are examples of queer twists in the point-of-view of miners; the two cases are exceptions, but queer twists of one kind or another are not exceptions.

I believe miners give best results over a long period of time when they are left alone. They like personality in a superintendent; they do not like bureaucracies, officiousness, flub-dub, welfare, nor Taylorism.

P. B. McDonald.

Boston, August 14.

Wet Method of Mercury Extraction

The Editor:

Sir—I have read Mr. Thornhill's interesting article in your esteemed journal of June 5 in which he refers to some experimental work in the wet treatment of mercury ores described by me in the *Australian Mining Standard* of June 8, 1911. As far as Australia is concerned, Mr. Thornhill is right in saying that the method there described has not been taken up or tried on a commercial scale. In his article he gives certain chemical formulae that might possibly be assumed to have been contained in my original paper. None, however, were given, hence I ask the favor of a little of your space to supplement Mr. Thornhill's formulae descriptive of my method with those that I conceive to be more representative, perhaps, of the method mentioned.

I may premise that HgS in going into solutions, under the circumstances considered, forms a thiosalt with the alkali metal, so that instead of a mercuric cation and a sulphide anion, there is formed HgS_2—mercuric disulphanion—with disodium cation $Na_2.HgS_2''$— soluble in certain conditions of concentration, but hydrolyzed on dilution with water into NaSH, HgS, and NaOH. This is an important point in working the method, a proper concentration of sodium sulphide and alkaline hydrate being necessary to the complete dissolution of HgS: the reaction outlined may be thus represented:

(1) $2Na_2S + HgS + H_2O \leftrightharpoons Na_2HgS_2 + NaSH + NaOH$

Under varying conditions of dilution and temperature the reaction is reversible; hence the necessity for carefully determining these points by actual tests on the ore to be treated.

Assuming that these conditions have been settled, the rest of the process is as follows: Zinc hydrate is added to completely decompose the mercury thiosalt and the excess of sodium sulphide thus:

(2) $Na_2HgS_2 + Na_2S + 2Zn(OH)_2 = HgS + 2ZnS + 4NaOH$

If now the precipitate of mixed sulphides be acted upon by H_2SO_4 or HCl, the latter preferably, if we are going to regenerate the $Zn(OH)_2$ cheaply, we produce H_2S, which can be passed into the NaOH solution in (2) partly regenerating solvent. Some mechanical loss is inevitable. These two reactions may be written thus:

(3) $HgS + 2ZnS + \begin{cases} 2H_2SO_4 \\ 4HCl \end{cases} = HgS + 2Zn \begin{cases} SO_4 \\ Cl_2 \end{cases} + 2H_2S$

(4) $2H_2S + 4NaOH = 2Na_2S + 4H_2O$

If metallic zinc be added to equation (3), mercury is reduced, an extra molecule of acid being needed and an extra molecule of H_2S liberated.

(5) $HgS + Zn + 2HCl = Hg + ZnCl_2 + H_2S$

Zinc hydrate may be regenerated from $ZnCl_2$ by milk of lime, thus:

$$ZnCl_2 + Ca(OH)_2 = Zn(OH)_2 + CaCl_2$$

This is perhaps better than the method suggested in the paper quoted, which proposed using the alkaline solvent solution to regenerate $Zn(OH)_2$. In operating the process as just described, there will therefore be an excess of $Zn(OH)_2$ and H_2S and a loss of HCl, should it be desired to reduce the HgS by the method proposed instead of distilling HgS at stage (3) as proposed in the original paper.

Charles A. Mulholland.

Sydney, Australia, July 21.

The waters of mineral springs have usually been studied by chemical analysis alone. Jacques Bardet, a French scientist, thinking that spectroscopic analysis would enable him to find traces of metals that had escaped analytical chemists has examined the waters of 54 springs from 34 health-resorts in France. He found that the waters always contained lead, that silver and tin were usually present, and that molybdenum and copper were frequent. He also found bismuth, zinc, and glucinium, and two metals that are considered extremely rare, namely, germanium and gallium. He also detected, but less commonly, antimony, cobalt, chromium, mercury, nickel, gold, thallium, titanium, vanadium, and tungsten. These results may account for the healing power of various mineral springs and may form a basis for theories of ore deposition. They certainly prove that some rare metals are more widely spread than has hitherto been supposed.

Flotation at the Central Mine, Broken Hill

By JAMES HEBBARD*

†Early Attempts at Frothing. While concentrating the galena in the lead ore produced from the Central mine, a valuable by-product was obtained in the form of slime assaying 18% lead, 20% zinc, and 16 oz. silver per ton. This came from an ore in which quartz and rhodonite were the chief gangue-minerals. In the course of ordinary operations, it had long been observed that a froth was formed containing high metallic values, in silver and lead particularly, whenever conditions were favorable, as, for instance, where the rotation of trommels, or the splash of the elevators or raff-wheels, or the motion of the jig-plungers, produced a violent agitation of the mill-water containing slime. Early in 1901 a series of experiments was carried out for the purpose of reproducing and accentuating the conditions responsible for this valuable float-concentrate. Experiments and tests, extending over several months, were made on slimes of varying degrees of fineness. Among the appliances tried was a series of funnel-shaped vessels with the small ends downward, each fitted with an overflow-lip. The bottom end of the funnel or cone-shaped vessel was fitted with a tap or plug discharging the contents into the next vessel in the series, and so on. To each vessel was attached, near the bottom, a water-pipe, as well as a pipe carrying compressed air. The object of the water was to provide an upward current for the contents of the vessel, while the object of the compressed air was to produce agitation, and enhance the agitation effect of the up-current of water, in the expectation of reproducing the conditions causing the 'float' or metallic froth. Speaking generally, these experiments were on the lines of a spitzkasten, with a strong up-current to produce an agitation of the slime-water, assisted by jets of compressed air. It was thus early recognized that the bubbles of froth noticed in the wet-concentration operations were due to the aeration produced by violent agitation, resulting from mechanical implements moving rapidly in water. In these experiments a metallic froth or scum could be produced and recovered assaying 26 oz. silver, 30% lead, and 22% zinc. The appliance employed is illustrated in Fig. 1.

[Up to that time the lead concentrate was the only marketable product from the ordinary water concentration. Besides calcite, the ore contained a good deal of rhodonite and garnet, each of which has a specific gravity close to that of blende. Thus water concentration could only yield a quartz tailing and a leady zinc-rhodonite-garnet middling.]

†Abstract of paper appearing in the Proceedings of the Australasian Institute of Mining Engineers, November 10, 1913.

*Manager of the Central Mine, Broken Hill, New South Wales.

Preliminary Tests. Early in 1903 an exhaustive series of laboratory tests was made on the lead by-product by flotation methods, using heated sulphuric acid and salt-cake solution. These tests yielded some slight measure of success on material specially prepared, that is, on grainy material from which both the coarse and fine had been eliminated, leaving it evenly sized. Certain classes of the material produced by our mills contained such a large proportion of carbonates—such as carbonates of manganese, lime, and lead—that no flotation could be secured except by a prohibitive consumption of acid. These tests were carefully made, but

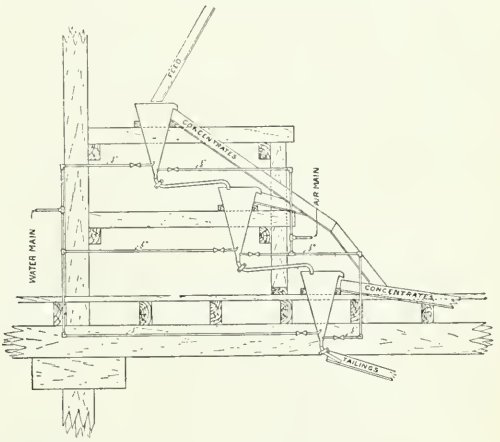


Fig. 1.

the best work done in the laboratory was not equal to that being secured on a commercial scale in the existing magnetic plant. The tests on these flotation methods were conducted in pans or vessels worked on the principles of spitzkasten, following the lines of Potter and Delprat. The first apparatus was constructed so that the liquors could be raised in temperature by the application of direct heat underneath the pan; but in the later types the temperature of the liquor in the pan or spitz-box was maintained by the injection of live steam into the storage-tank. In none of these tests was agitation employed, the material to be treated being fed practically dry on the surface of the liquor in a regular stream, and the heated liquor added through a pipe discharging near the bottom of the vessel, and given an upward inclination in order to produce an up-current in the box itself and a gentle overflow at the lip. A still surface was imperative in this operation, and it was equally evident that the operation depended largely for

its success on surface tension of the liquor, after the gas evolved by the action of the acid on the mineral carbonates had raised the particles. This surface tension was increased by the density attained in the one case by the salts formed from the mineral and gangue through the action of the sulphuric acid, and in the other by the addition of salt-cake. In all these experiments the liquor was returned by the ordinary type of air-lift, using compressed air at about 70-lb. pressure. These experiments definitely demonstrated:

1. That there was a limit to the size of the particle that could be buoyed up.

2. That any material below a certain size, no matter what its character—whether gangue or mineral—floated, owing to the density of the solution.

3. That if the finer particles of gangue were not eliminated before treatment they would be floated with the mineral, and lower its value in metals to such an extent as to make it unmarketable.

Slime, whether existing as a by-product of the ordinary wet-mill concentration or subsequently produced in preparing tailing for treatment, bulked so largely among the total material available for re-treatment that any process that failed in this direction was too limited in its scope to be of much value to the Central mine.

As far as any process up to date was concerned, slime had to be regarded as of no value except in so far as it was available for smelting. The Broken Hill Proprietary Co. had used a considerable quantity in this way, and had discovered that roasting or sintering the slime in open heaps after briquetting gave a fair product valuable for smelting, a good deal of the sulphur and a fair proportion of the zinc having been driven off. The Sulphide Corporation also sought to make its slime available by this means, but it was proved that the losses of metal were too great to justify this method of rendering the slime amenable to direct smelting.

Cattermole or Granulation Process. The foregoing experiments were abandoned on account of information received from London. C. F. Courtney, who was in England during the year 1902, advised that a discovery of considerable importance had been made; that laboratory trials gave every indication of success on a large scale; and that the process was so comprehensive as to include the finest slime and varying coarser sizes of particles up to ½ mm. diam. This was subsequently known as the Cattermole or granulation process, and consisted in the agitation of a mixture of pulp, oil, and water, containing a suitable acid, or an alkali with soap or other emulsifying agent, so as to agglomerate the oil-coated particles into granules. The oil was thus employed in a state of emulsion in water in the presence of an emulsifying agent, such as soap. After agitation the mixture was passed into an up-current separator or classifier to remove the lighter non-oil-coated particles from the agglomerated masses of oil-coated particles. The lighter sand having been eliminated, the pulp passed to a second series of agitators to increase the size of the granules, and thence to a second classifier for the removal of the heavy sand. From the bottom of this second classifier some granulated concentrate was recovered, but the heavy sand from the overflow also carried over, with the up-current, a large amount of granulated mineral. This mixture of granulated mineral and heavy sand passed then to a third series of agitators, and thence to a shaking table, where the granulated mineral, rendered more buoyant by directing jets of compressed air onto the surface of the moist pulp, was buoyed to the surface of the water and floated off the bottom of the table, while the gangue sank and was delivered over the end of the table.

In order to give this process a thorough trial, a model plant was sent from England and erected on the mine early in 1904. G. A. Chapman was specially appointed to conduct experiments with this plant, and started a long series of tests early in June of the same year. It was quickly demonstrated that the process was capable of making high recoveries of all the three metals from the very finest slime, whether taken from the current work of the mill or from old accumulations, and also that old tailing or new crude ore were amenable to treatment when crushed to a given fineness. The largest size of particle that could be recovered was ascertained to be about ½ mm., thus confirming the London work; but it was found that results improved with a decrease in size to impalpability.

In the early tests by Mr. Chapman, emulsions of the heavy oil of petroleum were used, but the cost was excessive, and it was found impossible to treat slime successfully. Emulsions of fatty acids, and also soft soap, were then tried, but proved prohibitive as to cost, except in the case of oleic acid. Oleic acid emulsion was found to act rapidly and effectively on crude ore as well as on all lead by-products, including slime.

Mr. Chapman's work on oils and the results obtained by him with the model plant using the granulation process were satisfactory, but it was thought wise to have these confirmed by an independent chemist, and therefore J. C. Moulden, the company's chief metallurgist at Cockle Creek, was called in, repeated the experiments, and amply confirmed Mr. Chapman's work. Later it was found possible also to reduce the quantity of oleic acid, as was proved by the following tests in December 1904:

Material used was crushed tailing mixed with slime.

Test No. 1. 3.5% oleic acid on mineral and 0.75% sulphuric acid circuit.

The cost of emulsion in this case was 10s. per ton of ore, but the results were excellent, the concentrate being recovered as partly granulated and partly float or froth.

In test No. 2, only 0.75% of oleic acid with the same (0.75%) sulphuric acid circuit, in which case the cost of emulsion amounted to 2s.3d. per ton of ore, the results being excellent, with all float concentrate, no granular material being formed. This test took considerably longer in agitation.

Erection of Large Plant. Mr. Chapman's tests, and their confirmation by Mr. Moulden, established the fact that a process was obtained that would, with suitable arrangements for crushing, efficiently handle the whole of the by-products of the wet mill, including slime. It

was accordingly decided to erect a plant on the lines of the model, with slight modifications as dictated by experience, capable of treating 100 tons per day, operating on a commercial scale.

It was clear, from experiments and observations, that the time of agitation was a factor in the aeration and oiling of the mineral particles. Therefore, reckoning from the size and capacity of the mixers in the model plant, a mixer was built of the following dimensions: 5

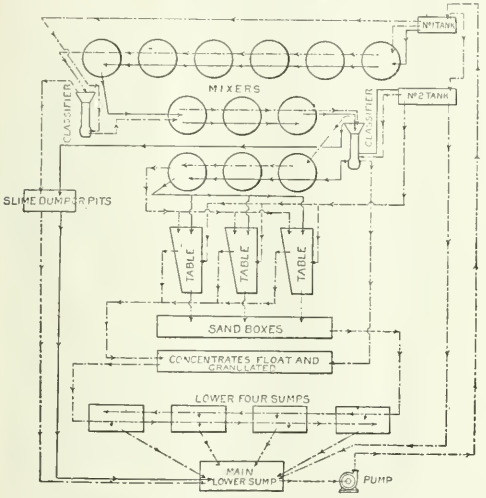


FIG. 2.

ft. deep and 3 ft. diam., with a wooden stirrer 2 ft. 6 in. diam. at bottom placed vertically and made to revolve at the rate of 350 r.p.m.

Experiments with this one mixer unit indicated that, to make the treatment continuous for the stipulated 100 tons per day, it would be necessary to have for the first unit a series of six mixers in order to allow of the proper cleaning of the particles and the thorough aeration of the whole mixture before the discharge of the material under treatment from the last of the series. The mixer was of the core-stirrer type.

Accordingly, the plant was designed on these lines, and consisted of:

1. Grinding apparatus.
2. Vat for emulsifying various oils.
3. Set of six mixers in series.
4. Upcasts for separating sand and float.
5. Second set of mixers for further aeration.
6. Upcasts for further separation of sand and float.
7. Third set of mixers for re-aeration.
8. Wilfley tables for the separation of coarse sand from granulated sulphide.

Early in 1905 the construction of this plant was commenced; it was completed at a cost of £11,000, and started work in July 1905. The method of treatment adopted was on the lines of the tests made in the experimental model plant, and may be briefly described. See Fig. 2.

The ore, reduced to a suitable fineness, was elevated to a hopper at the top of the building and fed into No. 1 mixer, where it was agitated with the solution, the emulsion (previously prepared on the bottom floor) being added at the same time, together with further sulphuric acid, if required. The feed of ground material and the addition of the circuit-liquor and reagents was maintained constantly and regularly. After passing through the first set of six mixers a pulp consisting of ground ore, acidulated water, and emulsion was passed to a hydraulic-sizing appliance known as an upcast, where the slime-gangue was eliminated by overflowing. The balance of the mixture was passed into the second set of mixers, beginning with No. 7, where more emulsion and sulphuric acid were added if necessary. The agitation and aeration were maintained and the pulp discharged from No. 9 into another upcast, where further slime-gangue was eliminated by overflow. The balance of the material was then passed to No. 10 mixer, and thence through No. 12 to the Wilfley tables. The separation on the tables was effected thus: Such concentrate as had been frothed by the aeration and agitation passed off the table immediately opposite the point of feeding. The granulated or 'air-bally' material remained in close contact with the table, along with the sand, but floated immediately under the influence of puffs of air (supplied through a pipe laid lengthwise and close to the table), and then floated off with the froth concentrate. The sand was delivered toward and at the end of the table, thus exactly reversing the relative positions of concentrate and tailing as ordinarily obtained if working by gravity concentration. The slime and sand were collected in one receptacle and the float and granulated concentrate in another, the surplus liquors in each case flowing to a common sump for re-use.

From the first day of operation the ease with which

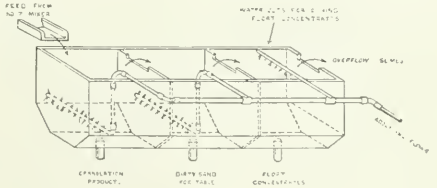


FIG. 3.

the float concentrate could be recovered was very striking; but the separation of the granulated concentrate from the coarse sand by tabling on a large scale was found to be a very delicate and difficult operation, and it was at once evident that 'spitz' separation would relieve the tables. The upcasts were also continually choking and proving a source of trouble, besides sending over large quantities of slime with the concentrate, thus reducing the grade of the product and lessening its market-value.

It was therefore decided, when the plant had been running for a few days only, to construct a small rectangular spitz-box for trial. This was introduced early in

August 1905, the feed to the spitz-box being prepared pulp discharged from No. 7 mixer.

It was found also, as soon as the plant started regular treatment, that the agitation was excessive, and mixers 10, 11, and 12 were cut out.

Cone-agitators made of phosphor bronze were tried, then centrifugal stirrers, but the scour both on the stirrer and the sides of the mixer, due to the impact of the sand, was so great that these had to be abandoned, although the agitation and aeration had been considerably increased.

The spitz-box in the slime-overflow circuit gave excellent results, and toward the end of August it was possible to obtain the requisite agitation by using the first six mixers only. A fresh spitz-box was placed in the position formerly occupied by vats 7 and 8, with arrangements for all tailing-flows, both slimes and sands, to deliver to No. 1 hutch of a special spitz on the floor beneath. The object of this spitz (3-compartment) was (1) to allow a settlement of the granulated material in the first compartment; (2) to effect a settlement of middling for re-treatment on tables in the second; (3) to provide for the deposition of clean sand and slime in the third, with an unrestricted overflow for the float material. Sprays on the surface of the liquor, and upcasting jets of water, were provided to assist the operation. Various simplified forms were later adopted as the process merged from partial to complete flotation, as illustrated in the experimental spitz-box for the granulation plant (Fig. 3).

At first the sand was ejected by sluicing out to a dam; but this being wasteful of circuit-liquor, and therefore also acid, it was decided to construct sand-boxes, through which, in turn, the suspended sand could be deposited—the liquor overflowing from these sand-boxes to be run to the pump-sump and thence re-circulated through the plant. By this means a closed circuit would be secured, and liquor-losses minimized. It was not until November that these sand-boxes were actually in use. Meantime, it was noted, particularly in slime-tests, that the operation was appreciably assisted by raising the temperature of the liquor. Steam jets were, therefore, introduced into the mixers in the plant early in September 1905.

Before advancing further with the evolution of the process as developed in the first large plant, it is perhaps advisable to refer here to certain experiments that mark a most important era in the history of the process.

Discovery of the Frothing Process. We now come to a stage when a remarkable development in the operation was discovered (strangely enough, at the same time both here and in the Patent Co.'s* laboratory in London), which had for its main principle the reversal of all previous operations, and consisted in the complete flotation of each particle of mineral independently in place of granulating the mineral particles and causing them to sink, thus not only revolutionizing the process, but greatly simplifying and cheapening it. The developments noted were mainly along the line of decreased consumption of oleic acid or oil, for example, from 3% oleic on ore, resulting in very little float, down to 1%, giving practically a complete float.

The following data from a report furnished by A. H. Higgins (March 16, 1905), indicate in more detail the nature of the experiments and the effect on the separation produced by varying the percentage of oleic acid:

Details of Experiments

Acid, %	Oleic, c.c.	Percentage of oleic on ore.	Time for aeration, min.	Temperature, C.	Remarks.
1.1	15	3.0	4	30.5°	Very little float
1.1	7.5	1.5	4½	31.0°	Rather more float
1.1	5.2	1.04	6	31.0°	Still more float
1.1	3.1	0.62	6	32.0°	Still more float
1.1	1.66	0.32	7	31.0°	Float vastly increased
1.1	0.5	0.10	8	31.0°	Float vastly increased

In every case the oleic acid has been measured in cubic centimetres and the percentages calculated as though they weighed grains; but, as the specific gravity of oleic is less than that of water (taken as 1), all percentages will be lower than those actually given.

The foregoing obviously proved that the reduction in the percentage of oleic acid materially altered the type or character of the oiling of the mineral particles—the higher percentage producing granules, which were precipitated, while the lower percentages produced a mineral froth. As the quantity of oleic acid decreased, the time required for oiling the mineral particles and aerating them was found to increase, and more froth formed. These tests, followed by many others, led to Messrs. Sulman, Picard, and Ballot's British patent of April 12, 1905, under which "finely powdered ore, suspended in acidified water, is mixed with a small proportion of an oily substance such as oleic acid, amounting to a fraction of 1% on the ore, and agitated until the oil-coated minerals form into a froth, which can be separated from the gangue by flotation. Heat may be applied to facilitate oiling, and either shaking tables or spitz-boxes may be used to separate the frothy mineral from the sands and the gangue slime."

To return now to the record of operations at the large plant, some successful tests were carried out in September, 1905, on dump-slime, by using this flotation method. Agitation was completed in six mixers (using cones) in 0.6 to 1% sulphuric acid at a temperature from 80-90° F. The quantity of oleic acid used in these tests was from 0.15 to 0.2% on the actual dry weight of slime treated. From the sixth mixer the pulp passed "with a good splash" to the first spitz, and the residues from this "with a good splash" to No. 2 spitz, and the tailing from this latter spitz-box was run into dams. These and other experiments emphasized the importance of dropping the pulp vertically into the spitz to assist aeration and subsequent flotation, and of heating the liquor to enhance the oiling of mineral particles.

The three-compartment spitz-box with upeast water-flows gave place, in turn, to a two compartment spitz-box without upeast flow, and this, in turn, was replaced

*[Minerals Separation Ltd.—Editor.]

by a single-compartment spitz, the latter being provided with a rigid flat board on which the feed was splashed to assist aeration. Conical spitz-boxes were tried, but not generally adopted.

From Granulation to Flotation. The plant had now been running for a couple of months on tailings and slimes from various sources, and during this time the frothing method was generally ousting the granulation process, until, finally, the superiority of the spitz-box and froth method was clearly demonstrated. The Wilfley tables of the original plant were then dismantled to make room for the sand-boxes already mentioned, and the granulation gave way to flotation with simple spitz-boxes early in October, after treatment of approximately 1700 tons of crude ore, tailing, and slime.

This method of working, thus briefly outlined, quickly established itself as capable of dealing with the company's ores and by-products, and Mr. Chapman's patent of September 1906 was taken out to protect the various discoveries made by supplementing Sulman, Picard, and Ballot's patent (No. 5032, 1905). Under Mr. Chapman's patent:

1. The ore, suitably crushed, is agitated with acidified water in the first mixer and heated.

2. Oleic acid is subsequently added in the second vessel.

3. The pulp is maintained at the desired temperature in third and following mixers, with violent agitation in each mixer to insure complete and thorough aeration.

A sequence of operations is thus arranged by which the solution, after the second agitator, is practically or entirely neutralized, so that the liquor in circuit as a whole is neutral, except at outset, when the ore is introduced.

The adoption of this flotation process with its neutral liquor allowed the use of iron parts where formerly, under the granulation method, with acid liquor, only wood or special metal could be used. For instance, the original wooden-cone mixers, which had been replaced by centrifugal stirrers of copper or beaters of regulus metal, were now replaced by four-armed stirrers of cast-iron.

A great difficulty lay in the grinding. The experiments had proved that the best work could be obtained on material that would pass through 40-mesh, and that practically the finer the material the better the recovery. The whole experience in the fine grinding had been with ball-mills in our magnetic plant, and accordingly a No. 8 Krupp dry ball-mill was attached to this plant as part of the equipment. The dry mill proved unsuitable, and, with considerable difficulty, it was converted to a wet mill. Even then its capacity, allowing for numerous break-downs partly due to forcing its capacity, was too limited, and two No. 5 Krupp wet ball-mills were installed to assist. Meantime, experiments proved conclusively that grinding-pans were superior in character of work, cost of maintenance, and power consumed, to the ball-mills for re-grinding tailing, whereupon we installed a grinding-plant which was gradually increased until the ball-mills were thrown out of use entirely. The character of the work was much improved, and it was then evident how much the progress of the process to a satisfactory stage of efficiency had been retarded by lack of efficient grinding appliances.

Extension of Plant. The operations of the first plant were commercially and technically successful, and an extension was completed, with all its appurtenances, including grinding-pans for the reduction of the material to the requisite degree of comminution, conveyor-belts for the disposal of the residues, together with bins for concentrates and tanks for storage of liquor, toward the end of 1906, at a cost of £25,000, the sum of £11,000 having been already spent on the initial experimental plant. The total quantity of material treated by this flotation plant was 135,808 tons, which yielded 45,147 tons of high-grade zinc concentrate. The plant continued in successful operation until the completion of the wet-mill zinc section, which was capable of supplying the quantity of zinc concentrate under contract. During the time this plant was in operation numerous tests were made with a view to increasing the aeration, which was recognized as the chief factor in flotation, and at the same time lessening the mechanical energy absorbed in aerating. Among these may be mentioned

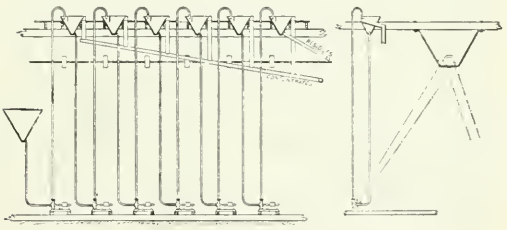


Fig. 4.

the nest of centrifugal pumps, as illustrated in Fig. 4. The pumps were worked in series, each one drawing a tailing from the preceding spitz and discharging into the next succeeding spitz. The aeration and flotation was produced satisfactorily, but it was soon found that the scour in the pumps, caused by the gritty nature of the material being pumped, was so great that the heavy maintenance would counteract the other advantages. Another expedient was to lift the whole of the tailing discharged from the first spitz by means of an air-lift. This also resulted in increased aeration, but it was found that the volume of liquor would have to be increased to an impracticable quantity to give the necessary velocity to carry the particles of ore, etc., up the rising leg of the pipe and prevent settling. An elevator was subsequently installed in its place to command the third spitz of the series. Further expedients were the insertion of a jet of air into a centrifugal pump used for raising liquors and material for re-treatment, the introduction of a jet of compressed air into the mixer boxes, and also the insertion of pipes in the mixer-boxes in such a position that air would be drawn into the bottom of the mixer by the rotation of the blades. As a result of

all these expedients, the conclusion was formed that the air, to be of value, must be finely comminuted, but that any addition was of value that would decrease the energy required to secure aeration by means of mechanical agitation.

Minerals Separation Plant. The Minerals Separation company, owners of the froth patents, purchased the tailing-dumps on the Central mine, and, by arrangement, a plant was designed and erected by the Sulphide Corporation for their treatment. The plant is shown in cross-section in Fig. 5, and was designed on previous experience for the treatment of 2000 tons per week. It was finished at a cost of £26,000 complete. The efficiency of the grinding-pans proved so great with the new design of positive pan that the plant was able easily to handle 5000 tons per week. This plant was responsible for the treatment of 709,999 tons of tailing, etc., and the production of 242,462 tons of concentrate up to the time it was shut-down in June, 1911, on the exhaustion of the dumps.

In connection with the Minerals Separation plant, it is important to note that the fact of the circuit being no longer acid, but neutral, has been taken advantage of, inasmuch as there is only one circuit through iron grinding-pans, agitators, and spitz-boxes. The original granulation plant, being designed for acid circuit, was equipped originally with wood throughout where liquor circulated, and with dry-crushing ball-mills for the same reason. Later, wet crushing was adopted, but with a fresh-water circuit, kept carefully separate from the acid circuit in which the actual separation took place. The successful development of the flotation process, however, has enabled both crushing and separation to be conducted in one and the same circuit, and has thus greatly simplified operations.

The liquor that was circulated through the Minerals Separation plant was approximately 25,000 gallons per hour. During the course of operation, therefore, over 600,000,000 gal.—equal to nearly 3,000,000 tons—has passed through the 12 iron grinding-pans of this plant without detrimental effect. No stronger evidence could be produced as to the freedom of the circuit-liquor from acidity. The maintenance charges on these iron pans are no heavier than corresponding charges on exactly similar grinding-pans in the lead-mill crusher-section, where fresh water only is used.

Following exhaustive experiments in the laboratory, various media have from time to time been used for long periods on the commercial scale, both in substitution for and in combination with oleic acid. Chief among such media are amyl alcohol, resin-oil, camphor-oil, pine-oil, and eucalyptus, with all of which ingredients good work has been obtained. Thus Nature, in close proximity to the vast bodies of complex ore, has provided the means for the concentration of such ores, for the essential oil of the Australian eucalyptus is one of the best-known media available for the successful exploitation of refractory Australian ores. It is of interest to note here that this application of an Australian product to the treatment of complex ores is the outcome of a research on the Central mine by an Australian metallurgist, Henry Lavers; and it was also in the milling-plant on the Central mine that eucalyptus oil was first used on a commercial scale for concentration by flotation.

This satisfactory stage having been reached, attention could now be turned to improvements in methods of handling, and, on suggestions from the owners of the patents, it was found that, by connecting the bottom of each spitz-box with the bottom of the next mixer in series, that all the spitz-boxes could be kept on one floor, thus improving the supervision of the work. An experimental plant of this nature was erected at the end of our No. 2 zinc section in September 1910, and, proving highly successful, the system was altered with confidence to this method of working. Experience shows that, for

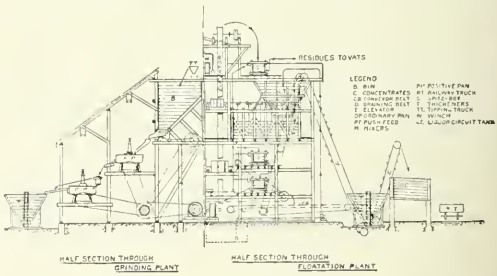


Fig. 5.

ideal work, the feed material should all pass through 40-mesh, but it is impossible to secure this condition of grinding at all times in the mill, as designed. Moreover, although the Sulphide Corporation was quite aware that improvements in character of plant and methods of operation generally were easily possible, their attention, by force of circumstances, had to be turned sedulously to increasing the production with the appliances at hand. As illustrating what the writer means by ideal grinding, the records of the average assays of residues show continually that where the average in zinc is from 2 to 2.5%, that portion remaining on 40-mesh will assay from 3 to 4% zinc. As illustrating the character of feed, and proving that the process is capable of handling successfully the very finest material, sizing-analyses by commercial screens of the feed to the zinc-section, zinc-concentrate as shipped, and de-leading plant lead-concentrate as shipped, are given:

Feed to zinc section.			Zinc concentrate.			De-leading lead.		
Through	On	%	Through	On	%	Through	On	%
	40	11.2		40	1.5		40	1.9
40	60	21.4	40	60	16.9	40	60	7.5
60	80	19.4	60	80	21.1	60	80	15.8
80	130	15.6	80	130	21.7	80	130	18.8
130	180	7.3	130	180	7.4	130	180	8.5
180		25.0	180		31.4	180		47.5

Results Obtained. For comparison with the work of the old mill, the following summary of results achieved by the existing plant will be of interest. This table

summarizes work done on a commercial scale in the Central mill over a period of twelve months, ending December 28, 1912, and demonstrates conclusively the vast improvement in concentration practice made possible by the adoption of the flotation process.

SUMMARY

	Prop.,	Assay value. Ag,	Pb,	Zn,	Recoveries. Ag,	Pb,	Zn,
	%	oz.	%	%	%	%	%
Lead concentrate ex lead section	16.0	33.1	67.0	6.7	44.7	72.4	6.1
Lead concentrate ex de-lead plant	1.4	50.9	62.5	12.5	5.9	5.8	1.0
Total lead concentrate	17.4	34.5	66.7	7.1	50.6	78.2	7.1
Zinc concentrate	32.7	16.1	8.1	46.4	42.1	15.9	84.7
Total concentrates	50.1	...	...	...	92.7	94.1	91.8

Modifications of the wet mill are now in hand for the improvement of the grinding, but it is felt that, as the proportion of lower-level ore increases, the grinding appliances will have to be increased in order to allow for the finer crystallization of the minerals in the ore as further depth is attained. The writer is of opinion that the figures quoted clearly show that if the ideal grinding is obtained the already high recoveries of metals will be further augmented.

It is unique in the history of concentration that so far-reaching and extensive a development should have reached its present state of perfection in so short a space of time, and more wonderful still that it should prove applicable in an equally masterly manner to so many other classes of ore. There can be little doubt left in the minds of those who have seen this new system of concentration that it must of necessity spread to all parts of the world.

SCIENTIFIC MANAGEMENT of the Watertown Arsenal saved $240,461 in one year. The saving on surplus stock alone amounted to $122,789 and there still remained an unnecessary surplus of $130,313. As a rule, too many supplies are carried. The manager of one of the best known and best managed concerns in the United States found that he had tied up in his store-rooms the equivalent of a year's output. By systematizing he carries only one-third of the year's business in stores, while the output has increased 50%. In another plant 3000 varieties of lace have been reduced to 300. A small printing plant with 200 items of stores found that 85 of these were superfluous. Seventy-six styles of pens were used in one Government department.

ASBESTOS. The total tonnage quarried in the Province of Quebec for 1914 was 2,127,395 tons. From this, $3,053,530 of asbestos was extracted, which make the average yield per ton of the rock $1.44. In 1913, this average was $1.45; in 1912, it was $1.38, and in 1911, it was $1.53. These figures have to cover all expenses of quarrying, milling, grading, and sacking of the asbestos, and profits. Last year the industry gave work to 3054 men, who received $1,285,697 in wages and salaries.

Increasing Spelter Production

With an ultimate capacity in view of 660,000 tons of spelter annually, the increases now being effected in the zinc smelters of the United States will not only have brought into being a number of entirely new plants, but will have rehabilitated smelters that had been entirely dismantled. The most important developments along this line will be the completion before the end of the current year of two smelters by the United States Steel Corporation. Its effect will be to remove from the open market the largest individual consumer of spelter in this country. The following tabulation is compiled showing where the bulk of the new production will come from:

Plant and location.	New retorts.	Increase, tons.
Hegeler Zinc Co., Danville, Ill.	1,800	7,200
Matthiessen Zinc Co., La Salle, Ill.	912	3,648
Prime Western Spelter Co., Iola, Kan.	2,600	10,400
Kirk Gas & Spelter Co., Iola, Kan.	2,800	11,200
Am. Z. L. & S. Co., Caney & Deering, Kan.	4,800	19,200
E. V. Lanyor, Pittsburg, Kan.	1,150	4,600
Cherokee Spelter Co., Bovee, Kan.	1,200	4,800
Pittsburg Zinc Co., Pittsburg, Kan.	530	2,120
Chanute Zinc Co., Chanute, Kan.	400	1,600
Nevada Zinc Co., Nevada, Mo.	1,200	4,800
George Nicholson, Dervar, Okla.	3,000	12,000
Am. Zinc & Chemical Co., Langloth, Pa.	2,680	10,700
U. S. Steel, Gary, Ind.	3,480	13,840
U. S. Steel, Donora, Pa.	7,640	30,560
National Zinc Co., Bartlesville, Okla.	1,200	4,800
U. S. Zinc Co., Pueblo, Colo.	400	1,600
Total new capacity	35,772	143,008
Extant January 1, 1915	119,606	478,424
Total capacity by end of 1915	155,378	621,512

The American Zinc & Chemical Co. started operations last year, its initial capacity being 864 retorts. The American Metal Co. controls this company. In addition to the increases noted above, the New Jersey Zinc Co., operating both east and west, has, it is understood, enlarged its capacity. A few months ago it was believed to have in operation a total of 21,992 retorts capable of producing about 55,000 tons of spelter. It has planned for $650,000 expenditure in New Jersey. The United States Smelting, Refining & Mining Co. will soon be a factor in spelter, the company having purchased some old plants now in the course of rehabilitation.—*Boston News Bureau.*

PROSPECTORS desirous of Government assistance should emigrate to Australia, where they have a chance, at least, of being helped instead of ignored. Up to the end of 1912 New South Wales had assisted prospectors to the tune of over $2,000,000, of which $60,000 was paid in 1912. Smaller amounts have been given by the other Australian States.

TRIPHOSPHATE OF CALCIUM added to the food of poultry in the proportion of 1 to 100 causes an increase of 27 to 31 per 1000 in the number of eggs laid. As this chemical sells for a comparatively low price there is no reason why it should not be adopted.

Dull Advertisements

By P. B. McDONALD

An article on advertising almost needs an apology. Not because mining men of all sorts are not keenly interested in advertising and advertisements—for the exact reverse is true—but because nearly all articles on advertising are intolerably dull. Full of statements that no one believes, and composed of arguments that everyone is tired of seeing, most "talks about advertising" are not worth reading—and are not read. For instance, it is constantly being said that "advertisements necessarily insure merit in the goods, because expensive advertising could not be continued unless the product were a solid one." It is, however, evident to nearly everyone that a very mediocre and indifferent article could be foisted upon a gullible public for years through advertising by a concern that shaped means to an end. For, that very thing has been, and is being, done constantly both in the United States and Canada. Proving that an article is a "solid one," moreover, is not the aim of advertising in a technical journal.

What a mining man wants to ascertain from an advertisement is whether or not a new tool or machine will serve to do his class of work. He is not helped by such broad claims as assert that the machine in question will do everything everywhere, as some advertisements do. A superintendent, engineer, or mine foreman wants to learn not what a "world-beater" in general a particular machine is, for he knows full well that no one machine or tool is adapted for everything, but he would like to learn just what class of work it was aimed to accomplish and to what it is suited.

It is solemnly proclaimed in a recent discussion of advertising that the average mining man "first hears of new equipment and tools through the advertising page," which is nonsense. Almost invariably he has heard of it in half a dozen other ways before the manufacturer gets around to advertise it. For the average mining man is rather more alert to pick up information on deserving new equipment than the manufacturer is to advertise it, since, if the machine is a success, the demand for it at first is likely to exceed the rate of manufacture. Furthermore, although the case may happen occasionally, it is somewhat of an insinuation against a mining man's possession of brains to assert that he has been so sleepy as not to hear or read of a deserving new machine until he sees it in an advertisement. Mining men are not quite so dull-witted as some advertising-managers.

Mining men read the advertising pages a good deal. They would read them a good deal more than they do if manufacturers would change their advertisements from the sameness that makes them trite, and if they would recognize that the readers are intelligent enough to appreciate as much of interest in the advertising pages as in the journal proper. This does not apply to standard old products that never change and are not supposed to change, and which are so simple in character as to be perfectly understood by everyone. But it applies to most of the equipment advertised in technical journals.

Strange to relate, very little information that is of any value is conveyed by advertisements, and that which *is* stated is frequently befogged in trivialities. If a mine superintendent wants to really learn about a new machine of which he has heard, he can get very little information as a rule from an advertisement of it. For instance, an advertisement will show a picture of the machine with the general information underneath that it "will suit your requirements," or "gives satisfaction" or "economy guaranteed." What the superintendent wants to known is its special field, its significant points (not "talking points"), and the "nature of the beast." At this stage of specialized machinery with each variety designed for a certain class of work, it is the most difficult matter conceivable to obtain any kind of an intelligent summary of a machine's points from an advertisement.

When an advertisement does state the points of a machine, they are liable to be inconsequential facts of no special interest to a mining man—details indicating nothing of the principle that he is seeking to weigh and understand.

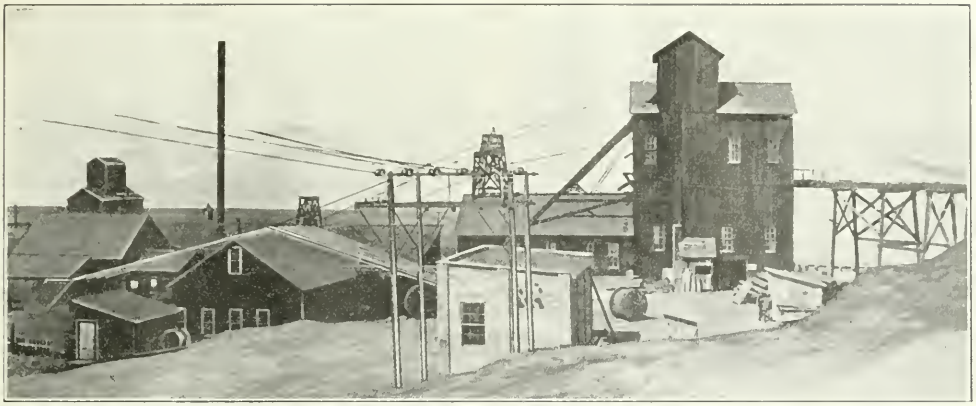
There is nothing more interesting to a mine-superintendent than intelligent information on practical mine-machinery. Some mining-machinery salesmen have the faculty of conveying such information about the equipment they sell. It is sometimes contained in miscellaneous articles in the technical journals. To a large extent it is obtainable nowhere, and the staff at the mine remains in ignorance of whether or not a new machine would do their work, since they do not feel like making a considerable expenditure to experiment with half-a-dozen new departures that may prove failures and disturb the routine at the mine.

Technical advertising, or advertising of more or less specialized equipment in technical publications is too much based on the assumption that the readers are babes in ignorance and incapable of appreciating anything but the insufferably dull and stereotyped nonsense that is too general to mean anything. [In our editorial columns we comment on this expression of opinion.—EDITOR.]

BUTTE has yielded more copper than any other district in the world, the total output to the close of 1913 being 6,154,196,000 lb., or about one-third of the total copper output of the United States. It has produced also $26,268,500 in gold, 275,119,000 oz. of silver, 11,300,000 lb. of lead, and 181,540,000 lb. of zinc. The values of these metals are as follows:

Gold	$26,268,500	Lead	513,500
Silver	191,765,300	Zinc	$12,093,600
Copper	865,794,300		
			$1,096,435,200

A large part of the output has come from an area of but a few square miles, which so far as value is concerned, has undoubtedly been the most productive metalliferous area of its size in the world.



THE PENROSE SHAFT, LEADVILLE, COLORADO.

Unwatering the Down-Town District at Leadville

By AN OCCASIONAL CORRESPONDENT

Of the world's mines and mining districts there are some half score or more that stand out in such contrast as to make those who have knowledge of their mineralization wonder at the magnitude of nature's work. More than once has the discovery of great mineral deposits in some favored country changed the course of world events. Leadville, with a production of around $400,000,000 must be reckoned as one of these great mining districts—not only because of its gross output, but because of the magnitude and variety of its mineralization. For 16 years placer miners worked the gulches throughout the district and tramped over the hills under which lay greater treasure. Then for 31 years practical and theoretical miners reaped a bountiful harvest from the silver, lead, gold, iron, and iron manganese deposits, neglecting veritable mountains of oxidized zinc ore, from which have been shipped millions of tons since 1910.

As is well known to many, the lead and zinc ores occur in sedimentary beds of limestone and quartzite among which are interbedded and intruded sheets and sills of gray and white porphyry. From the eastern part of the district westward there occurs a series of great north and south faults and on the east side of each of these faults the formations have been forced up so that it is like great stair-steps rising from the west to the east. The Carbonate fault passed just east of the city of Leadville, and the formations west of it and lying deep under the city itself are included in what is called the Down-Town district.

The Down-Town district, by reason of the greater depth of the ore-bearing contacts and the presence of water, was not worked until after the more available orebodies had been extensively exploited. Just when the first ore was shipped from west of the Carbonate fault is not known to me, probably before 1890. The Penrose shaft found ore in February 1893. From the first discoveries until 1896 over a dozen different mines were in operation and enormous ore-shoots were opened up; the Penrose, Coronado, Sixth St., P. O. S., and many other well-known shafts were working. In that year a serious strike of miners, which included pump-men, caused a shut-down all over the camp, and the Down-Town district, East Fryer hill and other wet districts were flooded. In 1898 the Home Mining Co. unwatered the Penrose shaft and operated the consolidated mines until 1904, when they turned the holdings over to the Midas Co., which operated until the panic of 1907. Just before closing-down, the Midas Co. sank the Penrose shaft from the 600-ft. level, where the lowest workings on the upper ore-contact had been, down to the 900-ft. level, where an additional flow of water was encountered, so heavy that the pumping equipment proved inadequate.

After 1907 the entire area lay under water, until, through the efforts of former Governor Jesse F. McDonald, about 400 acres in the Down-Town area, including fifteen or more mines, have now been taken under lease and a company organized to unwater and continue the working of the ground. The leases run for 20 years. When the variety of ownership is considered, the securing of leases and harmonizing all the interests was a stupendous task splendidly accomplished.

After considering the many ways of handling mine-water, it was decided to use centrifugal pumps. Sulzer Bros. of Switzerland, famous makers of this class of pump, were considered as manufacturers, but on account of the European war they could not guarantee the date of completion of any pumps nor in any way insure delivery, so negotiations with them were dropped and the

contract eventually let to the Providence Engineering Works of Providence, Rhode Island. Four pumps were ordered; all are just alike except that two have frames to work in the shaft and two are mounted for placing in the station. The pumps were installed in the Penrose shaft and operations commenced on May 8, 1915. From May 8 until June 2 only one pump was running most of the time; the water would be lowered with the two pumps and then held at that level with one pump until the ground was sure to be drained. This was a safety measure to prevent lowering the water too rapidly, which might cause some obstruction to break loose in the old workings and flood the pumps. Since June 8, it has been necessary to run both shaft-pumps. At the date of writing, July 10, the water has been lowered 410 ft. and is being held at that level while a station is being cut for the other two pumps. As shown in Fig. 1 the two station-pumps will work in relays, taking the water from the pumps in the shaft and throwing it to the surface. After the unwatering is completed new pumps will probably be installed on the bottom level that will be capable of throwing the water clear to the surface.

The pumps are vertical two-stage, enclosed impeller type, operating at 1800 r.p.m. The impellers are about 17 inches in diameter and between the blades the five openings are each $2\frac{3}{8}$ in. by $1\frac{1}{4}$ in. giving a combined peripheral discharge opening of 14.84 sq. in. The dimensions of the two impellers are exactly the same. The pumps are designed to handle 1500 gallons under 410-ft. head when running at 1765 r.p.m. They are direct-connected to 300 hp. G. E. induction motors using 3-phase alternating current. The current is obtained from the Colorado Power Co. and the cycle is $61\frac{1}{2}$, which gives a speed of 1800 r.p.m., or 35 r.p.m. faster than the designers of the pump stipulated.

The pump and motor each weigh approximately two tons, but, including the frame-work, suction, and first length of the discharge-pipe, the total weight is about $7\frac{1}{2}$ tons. Fig. 1 shows the arrangement of the cables for handling the pumps. The cables are wound on steam-winches. With this arrangement a three-rope block and tackle is secured. The Penrose shaft is three-compartment; the two outside compartments contain the shaft pumps and in the centre compartment a skip is operated. Another sheave, not shown in the sketch, is placed over each pump-compartment over which pass cables for lowering the lengths of the column-pipe. To start the pumps it is necessary to lower them until the water is above the bottom impeller. Under these conditions the pumps also throw the maximum quantity. As the water lowers on the suction the pumps throw less and require less power, but probably the greatest efficiency is when there is no distance of suction. The discharge column is of 10 in. diam. with screwed flange-joints. The first length above the pump is held by a cross-head working on the guides and into a slip joint of the usual construction.

Some of the mechanical details are worthy of mention. The motor-bearings are oiled from a reservoir at surface. The oil passes down the shaft from the top bearing to the bottom thrust-bearing and into a pan that revolves with the shafting. The centrifugal force throws the oil from this pan into a pipe leading back to the reservoir on top. The pump-bearings do not use oil, but receive water, which is led to them from the discharge-column after being strained to remove any grit. The bottom pump-bearing consists of annular rings on the shafting, which rests on *lignum vitae* surfaces in the bearing. Between the impellers and the bottom impeller and the suction the water is prevented from flowing back by labyrinths or annular rings and grooves fitting into companion grooves in the pump-casing. Under the pressure of approximately 200 lb. some is bound to work by. To prevent a pressure being developed on the top of the upper impeller, the water that leaks by the labyrinths is led through a pipe back into the pump and prevents a serious thrust against the bottom bearing. The smoothness of running is remarkable. The pumps hang in the shaft just like a skip with no wedging or blocking, yet only

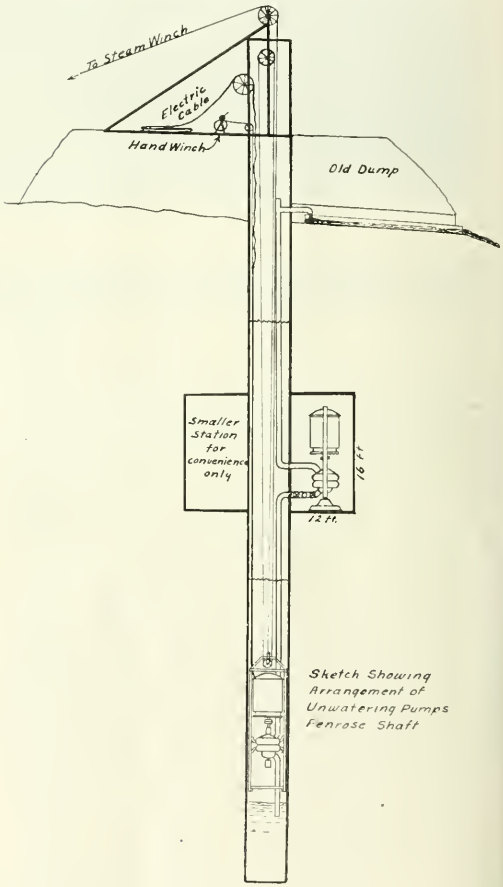


FIG. 1.

FIG. 3. SHOWING THE VOLUME OF WATER PUMPED.

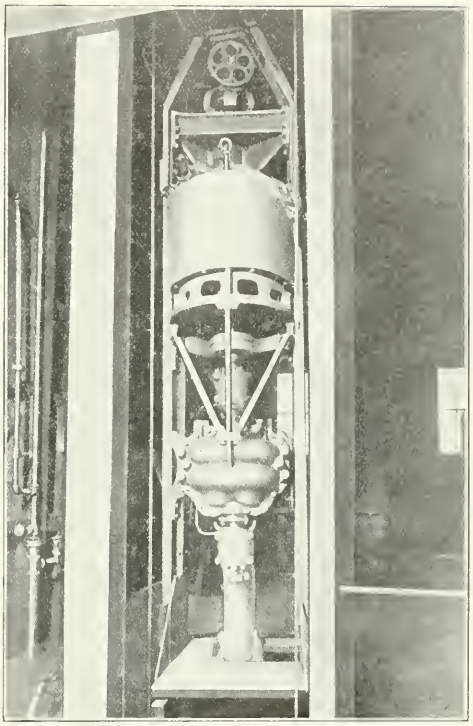


FIG. 2. SINKING PUMP READY TO BE LOWERED.

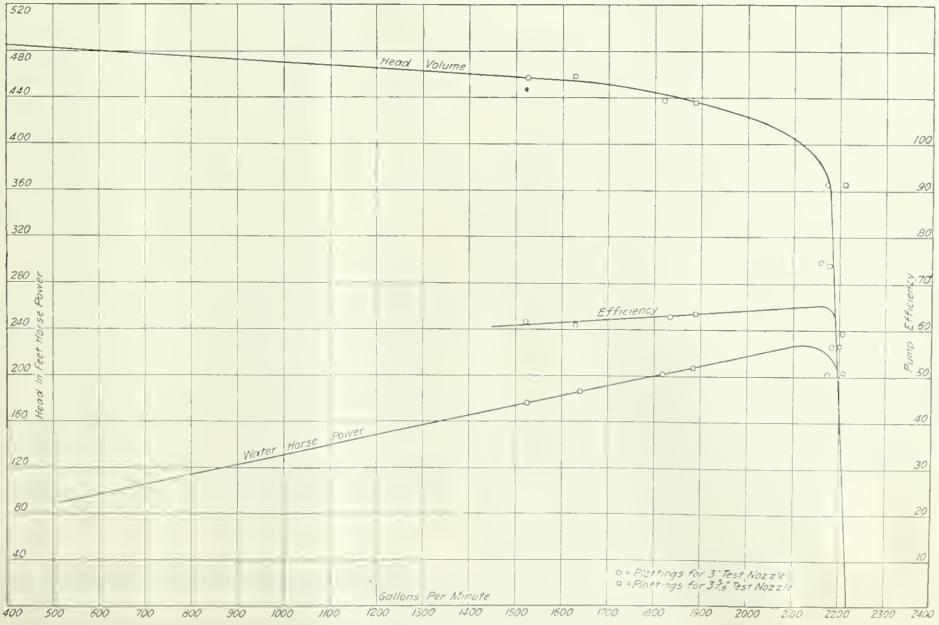


FIG. 4. EFFICIENCY CURVE OF PUMP.

the faintest vibration is noticeable. To those accustomed to the chugging of the steam-sinkers the contrast is very marked. The pump part of the coupling between pump and motor is shown in Fig. 2. The motor part of the coupling is the same and bolts pass through the holes. Hard-rubber washers around the bolts allow a certain amount of 'give' in the coupling. Fig. 2 also gives an idea of the small size of the pumps compared to the volume of water they are throwing, as shown in Fig. 3.

The electrical power comes to Leadville over the main line of the Colorado Power Co., at 100,000 volts. This line, 200 miles long, connects hydro-electric plants at Shoshone in the western part of the state and those near Boulder in the central part. Denver secures a large portion of its power from this line, which is one of the great electric-transmission feats of modern times. At the Leadville sub-station the power is stepped-down to 6600 volts and at the mine it is stepped-down from 6600 to 550 volts. From the mine-transformers the current passes to bus-bars on the switchboard. From the bus-bars the current for each pump passes through two switches to the electric cable leading down the shaft. One of these switches throws the current through an auto-transformer or starting-box and is used for starting the pump. As soon as the pump is up to speed this switch is released and the other switch immediately thrown-in, allowing the current to go direct to the pump. A timing arrangement prevents the running-switch from being thrown-in except just after the starting-switch has been released. The cables down the shaft are all the same and consist of three multiple-strand conductors each of 250,000 circular mills area. These are rubber-insulated and jute-filled. Around the conductors there is a double armour of wire wound in opposite directions, and between the wire armour and outside are layers of marlin. The completed cable is of 3-in. diam. and weighs 12 lb. per foot. Fig. 1 shows the method of holding the cable in the shaft by means of a steel cable wound on a hand-winch.

In Fig. 4 is given a copy of the efficiency curve plotted from the tests on the pump at the factory before shipment. One of the operators present at this test has told me that the pump was sucking about 10 ft. during this test. There is no method of testing the pumps now except in a rough way. It is estimated that the pumps throw 2000 gallons each against the 410-ft. head, which they now have when the water is well up to the pump. As the water lowers from the pump, however, the capacity of the pump decreases. The efficiency of the motor is said to be about 93%. The cost of each pump with its motor is under $4000. Power costs 9 mills per kw.-hour or the company has the option of paying $6.50 per month on the first 100 hp., $4.50 on the next 400, and $3.50 from 500 kw. up. If we assume an efficiency of 60% for the pump and 93% for the motor, giving an over-all efficiency of 56%, the actual cost per water horse-power per hour (including friction in the pipes) is 1.2 cents. I have tested steam-sinking pumps (usually under adverse conditions, however) and the comparison of cost with the above is only about 1 to 10. These are not the most efficient types of electric pumps, the plunger-pumps showing greater efficiences, but when we consider the volume of water thrown compared to the space occupied and the ease of handling, these pumps are deserving of the highest commendation and signify an important step forward in the method of unwatering flooded mines. At the outset some trouble was encountered with the motor, but, since this was remedied, the work has proceeded practically without a hitch. Simeon McDonald is in immediate charge of the work assisted by William Angus, master mechanic. C. D. Criley is electrician and the Providence Engineering Co. is represented on the ground by H. S. Arnold. Every courtesy is shown to engineers and others desirous of inspecting the operations.

Causes of misfires in blasting underground are as follows, according to J. D. Marquard of the Chemical, Metallurgical and Mining Society of South Africa. (1) Improper distribution of detonating force; (2) weak detonators; (3) damp detonators; (4) sawdust in detonators; (5) grease in detonators; (6) working ends of detonators pointing wrong ways; (7) axes of detonators and charges out of alignment; (8) detonators setting charges alight; (9) improper fixing of detonators to fuses; (10) improper fixing of detonator and fuse to primer-cartridge; (11) non-greasing fuse and detonator for wet holes; (12) choking fuse; (13) fuse damaged by tamping-rod; (14) irregular fuse; (15) deteriorated fuse; (16) wet fuse; (17) bunching fuses; (18) omitting to light fuse; (19) bad quality of explosives used; (20) deteriorated cartridges as primers; (21) deteriorated cartridge in between other cartridges; (22) air-cushions between cartridges; (23) tamping in between cartridges; (24) improper tamping or confinement of charges; (25) exudation; (26) running fuse (so-called); (27) improper and unscientific charging; (28) explosives forced into cracks after explosions; (29) explosives burning and smothering charge; (30) cut-outs; (31) insensitive explosives; (32) over-charging; (33) improper cleaning of sludge out of hole before charging; (34) contraventions of the mining regulations; (35) disobedience, indifference, carelessness, etc.

Bombs of military origin are all too familiar. Volcanic bombs consisting of round, elliptical, or discoidal pieces of lava from an inch to many feet in diameter are not so often mentioned. In Bolivia they cover many miles along the railway leading to Oruro. They are formed by explosions of steam in the column of ascending lava in the pipe of a volcano, and are thoroughly molten when ejected. The rotary motion imparted by the ejection gives them a circular form and the amount of "flattening at the poles" is a measure of their rapidity of rotation and fluidity.

House rent at the Treadwell mines is $10 to $15 per month for homes with baths and steam heat, and electric light. Room rent for single men $4 per month; board $25 per month.

Mining and Milling in Wisconsin

By CLARENCE A. WRIGHT

*The Wisconsin lead and zinc district includes not only the southwest corner of Wisconsin, but also the adjacent parts of Illinois and Iowa. The district has produced lead ores for many years, but now the zinc output is of increasing importance, having risen from 11,540 tons of spelter in 1906 to 35,088 tons in 1913. The lead production is only about one-tenth the latter figure.

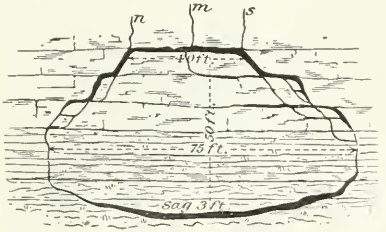
The ores consist chiefly of sphalerite, smithsonite, galena, and marcasite, and occur principally in the Platteville (Ordovician) limestone, or near the base of the over-lying Galena limestone, either in crevices, joints and openings, or disseminated throughout the limestone. The fissures, known as 'ranges,' are in many places parallel, having a nearly east-and-west direction, though there is a subordinate north-and-south system; they are best developed in the upper ore-beds. 'Pitches and flats' are characteristic of the district. Most of the sphalerite is found in them. These occur principally in the Galena limestone; below them are found the disseminated deposits. Above and near the level of ground-water, most of the galena and smithsonite are found, below that level sphalerite and marcasite predominate, though a little galena is present.

Prospecting is commonly done with a churn-drill, as the orebodies are not deep-lying. It is usually done by contract at 75c. to $1 per foot; the holes are placed 100 to 300 ft. apart, using intermediate holes for definitely determining the outline of orebodies when found. Churn-drills are better for this purpose than diamond-drills, as the quantities of flint occurring in the limestone give less trouble, and the 6 to 7-in. hole made by the former gives a better sample than the 1½ to 2½-in. core of the diamond-drill. Prospecting is aided by the ascertained fact that bodies of blende are more apt to be found below groundwater-level where lead ores are known to occur above.

Mining is done through vertical shafts, 100 to 200 ft. deep, and usually only from one level, as few of the orebodies are over 40 ft. thick. Underhand stoping is the usual practice, using one or two benches, according to the height of the face. The broken ore is allowed to work its way to the bottom, where it can be shoveled into cars. Special care must be taken to guard against falls of roof. Little timber is used, pillars 10 to 20 ft. thick being left at intervals of 20 to 50 ft. The average distance between shafts is 300 ft. They are cribbed from the surface down to solid rock, and few of them have ladderways, the men being raised or lowered in the buckets and cages.

Several makes of air-drills are used. The holes are 6 to 8 ft. deep in stoping, 10 to 14-ft. holes are drilled in taking up the lower benches. The powder most in vogue is 40% gelatin, although ammonia dynamite is largely employed where the holes are fairly dry. The drillers prepare the cartridge and load the holes themselves. The quantity of powder averages 1 lb. per ton of rock broken. A piece of sheet-iron is commonly laid down for the convenience of the shovelers, who load the ore into cylindrical 'tubs' 28 by 30 in. that hold 1000 lb. each. These are pushed by hand or hauled by mules to the shafts. Where cars are used they are hoisted in cages. The water occurring in the mines, varying from 200 to 1500 gal. per min., is easily handled.

Both electric and steam hoists are used; no attempt at counterbalancing is made, the buckets being hoisted by power and lowered by gravity. Signaling is done by



PITCHES AND FLATS. *m*, *n*, AND *s* ARE CREVICES.

pull-bells, but a few electric bells are in use. When the bucket has been hoisted to the top of the head-frame, the hoist-man covers the shaft with a lid, to prevent any material falling down it, and then dumps the load into a chute leading directly to the grizzly over the storage-bin. The latter, built of timber and having a capacity of 100 to 200 tons, usually serves as the mill-bin. Where more than one shaft supplies the mill, the ore is trammed to the mill-bin by surface or aerial tramways.

The mills of this district are much like those at Joplin, but are smaller and have less capacity, as more iron sulphide is present and the feed of the jigs must therefore be lighter. The mills range in capacity from 75 to 150 tons per 10-hr. shift. They are usually built of wood on concrete foundations and are of the level-site type. The course of the ore through the mill is shown by the accompanying flow-sheet. The large pieces caught on the grizzlies are broken by sledge-hammer; 5 to 25% of waste is thus sorted out and rejected. The work is done by the screen-men, who are paid $2.30 per day. The undersize, under 5-in. ring, goes to the mill-bin, whence it is fed to Blake crushers that reduce it to 2-in. ring. It next goes to a set of rolls, which reduce it to ⅝-in. size, and then by an elevator to trommels 6 to 12 ft. long, 3 ft. in diameter, and with 1½-in. holes. The undersize goes

*Abstract of Technical Paper 95, U. S. Bureau of Mines.

to the first jig, the oversize to a set of rolls and back to the trommel.

The Cooley jig, similar in principle to the Harz, is most in use. Sometimes rougher- and cleaner-jigs are used, in other mills only one jig is employed. This latter is satisfactory for ore in which the minerals are coarse and there is a large proportion of marcasite. It has the advantage of lower first cost, and requires less labor, power, and repairs. In the one-jig system eight cells, divided into two sections, are usual. The lead concentrate, if any, is caught in the first cell, and zinc concentrate on the first, second, third, fourth, fifth, and six screens, and the hutch of the seventh. The middling is re-crushed and returned to the feed. In handling the fine material tables are little used, for they do not yield a clean concentrate, as the marcasite and sphalerite have almost identical specific gravity. In one case tables are used to save the iron sulphide, which is shipped to acid plants. The usual practice is to obtain as much of the zinc material as possible from the jigs, the overflow water being allowed to return to the pond. Tests have been made with Wilfley tables, which showed that the iron and zinc sulphides would be successfully separated, but it is still a question whether enough 40% zinc concentrate can be obtained in this way to make the operation profitable.

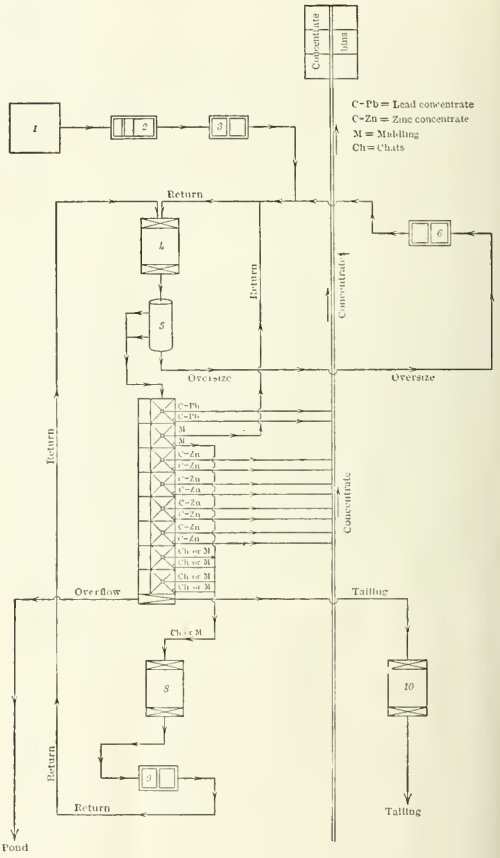
Most of the concentrate ranges from 30 to 40% zinc and is subjected to a light roast in revolving cylinders, lined with brick, and then passed through magnetic separators. In this way the zinc content is raised to 57 to 60% Zn. Operators that have no roaster haul their concentrate to the local roasting-plant for treatment. The total cost of treatment is $2 to $3 per ton. Average assays are as follows:

	Zn%	Fe%
First concentrate	33.91	17.85
Second "	59.53	1.99
Middling produced	8.71	....
Tailing "	4.64	....
Zinc recovery	91.54%	

Losses occur in the mining, where 15 to 30% of the ore is left in pillars; a little zinc is also lost in the waste sorted out. The greatest loss is in milling, the average recovery being 70 to 75%. The recovery in the second concentration is 90 to 95%, or a net recovery of 65 to 70%. Including the losses in smelting the net recovery of spelter from the mine is probably 40 to 50%. Few of the companies have any exact records as to the losses incurred.

Labor conditions in the district are much the same as at Joplin; there are no unions. Underground the shift is 8 to 9 hr., for surface and mill-work the time is 9 to 10 hours. A few companies operate two shifts throughout; two shifts underground and one in the mill is more common. The average wage is $2.61 per shift, and ranges from $2.27 for surface labor to $3.08 for engineers and helpers. Living costs are low and the work is steady, so the scale does not compare so unfavorably with the wages in the Rocky Mountain states as might be supposed.

It is difficult to obtain representative figures of cost, as the methods of bookkeeping used by the various companies are so diverse. The following costs, however, represent the average of several of the most important mines and mills. The cost of power is not distributed



FLOW-SHEET OF A REPRESENTATIVE LEAD AND ZINC CONCENTRATING MILL IN THE WISCONSIN DISTRICT.

1, hopper, capacity 150 tons; 2, crusher, 14-in. Blake type; 3, rolls, 24-in.; 4, elevator (feed); 5, trommel, 36 by 96 in., with ½-in. round perforations; 6, rolls, 24-in; 7, jig, eight 30 by 42-in. cells; 8, elevator (middlings and chats); 9, rolls (for middlings and chats), 18-in.; 10, elevator (tailing).

over the operations to which it applies, but is given as a separate item.

Mining (labor, supplies, repairs)	Per ton
Drilling	$0.1296
Blasting	0.1243
Shoveling, hoisting, and tramming	0.3426
Milling	0.1565
Pumping	0.0103
Power	0.2804
General	0.2416
Total per ton mined and milled	$1.2853
Average cost per ton of concentrate produced	$15.635

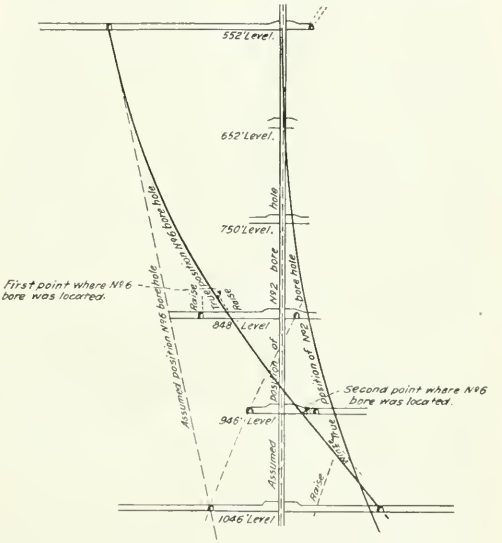
Deflection of a Diamond-Drill Bore

By ERNEST T. PRESTON*

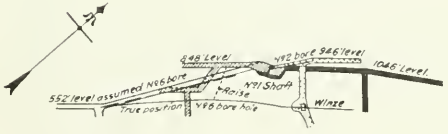
†In May, 1902, a vertical diamond-drill hole (No. 2) was started at the bottom of the No. 1 shaft on the Iron Duke lease of the Associated Northern Blocks, at a point 562 ft. below the surface. After boring for 622 ft. or to a depth of 1182 ft. from the surface, shaft-sinking was resumed upon the bore-hole, which retained its vertical course for about 50 ft., when it was found that the hole started to deflect to the east and north, leaving the shaft at about 100 ft. Cross-cuts were driven at the 750-ft., 848-ft., and 946-ft. levels, each one in turn exposing the hole but not the ore that had been reported at 948 feet.

The accompanying plan and section will illustrate the course taken by this borehole.

No. 6 bore-hole was started in September from a point in the west cross-cut on the 550-ft. level at an angle of 78° and N 28° E, its purpose being to confirm the assays reported in the No. 2 hole. When 490 ft. of boring had been done ore was reported and continued with increasing assay-value to 500 ft. This apparently practically confirmed the results reported from the No. 2 hole. On the assumption that the hole had not varied greatly from its theoretical position, a cross-cut was started west at the 1046-ft. level. Strangely enough, where the ore should have occurred, a low-grade pyritic lode was encountered; prospecting was at once started in this lode by driving and raising, but the assay-values cut out and no hole could be found. The company's surveyor, R. Falconer, then made a survey of the hole, with a clinostat made by W. R. Bawden, which showed the hole to have flattened considerably, but no correct bearing for direction could be arrived at, the difference in the compass-readings being so great as to completely condemn them. The next work was a cross-cut west at the 848-ft. level, in the hope of picking up the hole there, but after a large amount of driving, raising, and cross-cutting, no results were obtained and this cross-cut was discontinued. At this time Mr. Falconer left the mine and the writer took over the surveying for the company. My first work was to re-survey the hole, checking it several times, with practically the same result as that obtained by the previous survey in regard to underlay, but the compass-readings differed as much as 90°. The jelly used was most probably the cause of this trouble, as after the needle had been submerged in it for about a day the jelly seemed to attack the needle and the pivot on which it swung; the steel became soft and completely demagnetised. Another trouble was to get the jelly to set, as it had to be made very thin to enable the needle to work with as little resistance as possible, and, again, the jelly would not set properly at a temperature greater than 65 to 70° F. This hole was full of water and the temperature was 78°, so that fully two-thirds of the time when the clinostat was drawn up the jelly would not be set, which meant re-melting and lowering again. This difficulty can, I think, be overcome, as in mentioning it



Transverse Section N°1 Shaft.



Plan View

Scale; 1 Inch = 120 Feet.

to Mr. Mann, Government Analyst, he suggested trying Agar jelly, which is a pure vegetal matter and does not attack the needle. Another great advantage is that Agar jelly will set at 104° F., and as there is only 1% of solid used it is very thin when heated and therefore offers little resistance to the needle. So far, my experiments with the jelly have been conducted on the surface only.

The clinostat survey was accepted as to dip, and it was also assumed that the bearing had not altered from the direction at which it started. An east cross-cut was put in at the 1046-ft. level, and, when under the point where the ore was expected, a raise was put up for a distance

*Since deceased.

†Abstract *Monthly Journal* of the Chamber of Mines of Western Australia, at Kalgoorlie.

of 40 ft., in which was encountered a small pyritic body of no value. This work was then stopped, the raise being too high to work conveniently. The next thing was to have a strong magnet made and lowered down the hole to the 848-ft. level, where most of the work was done, to see if any attraction could be noticed on the compass-needle of a theodolite fixed at this level. This was quite a failure, as after experimenting on the surface with the magnet connected with the dynamo with a current of 110 volts, no attraction could be noticed when the magnet and needle were more than 10 ft. apart.

As there was a quantity of water coming through the rock in several places overhead at the 848-ft. level we thought that some of this water might be from the bore-hole. To test this a strong solution of permanganate of potash was put down the hole and within half an hour the colored solution could be seen percolating through to the 848-ft. level; this was equal to a depth of 310 ft. down the hole. A raise was then started to follow up the discolored rock; the raise went up very flat for about 50 ft. in a south-easterly direction when the coloration was lost and although more of the solution was put down the hole it would not percolate through. It was thought that the 'firing' in the raise must have blocked up the hole, and being doubtful as to whether we should open up the raise to the left or right, we sounded by lowering a double fuse and two caps down the hole and firing them. At this level this test proved the hole to be on the south side of the raise, and we thereupon opened a stope for 12 ft. and exposed the hole. (See plan). A survey made to fix the exact position of this point disclosed the fact that the hole at 300 ft. had deviated in bearing 18 ft. and had flattened 60 ft., the angle of dip being 58° instead of 78° as started.

This result proved the clinostat survey to be practically correct as far as dip was concerned, and gave us an idea of the direction, but not the exact bearing, because the line of the bore took the form of a curve. From this datum careful calculations were made to determine at what point to start driving from the east cross-cut to find the hole at the 948-ft. level. Having determined this, a drift was put in, but without any good result, and, failing to find the hole at a given point, the drift was continued another 20 ft. We then stoped back along the drift, thinking we were under the hole. This work, also, was unsuccessful. The hole being blocked just below the 848-ft. level, we were prevented from sounding, so the diamond-drill was called in to push the obstruction down; this was easily done for about 50 ft. in two shifts; then the obstruction became hard and fast, and could not be moved, notwithstanding the weight of 400 ft. of drill-rods with a drop of from three to ten feet. This work was continued for four days without perceptible success. Instructions were then given to stop at the end of the shift. Almost immediately the obstruction began to move and within four hours the hole was cleared down to the depth required. A few shots were then fired down the hole at the 948-ft. level, which sounded to the west of the drift, and a cross-cut put in for a distance of six feet exposed the hole. From this level a winze was sunk following the course of the hole down to the point where ore had been reported. The winze was continued for a further 20 ft. and then stopped with the intention of connecting it with a raise from the 1046-ft. level.

A survey of the hole made with the theodolite proved that from the 948-ft. level to the bottom of the winze; the hole had not continued its curvilinear course either in dip or direction, but had kept the one straight line for this length, showing that one cannot make certain of picking it up at any distance ahead.

Coeur d'Alene. The production of this district for 1913 was as follows: Gold, $81,749; silver, 9,337,109 oz.; copper, 5,097,894 lb.; lead, 296,740,946 lb.; and zinc, 21,415,565 lb., valued in all at $20,767,410. The total value of all the metals produced in the district since mining began is approximately $262,608,000. The rocks in which the Coeur d'Alene ores are found belong to the Belt series. These beds in the Coeur d'Alene district have been crumpled into folds and have been intruded by masses of molten material which, on cooling, solidified as a granitic rock known as quartz monzonite. During or after the solidification of the igneous rock the region was broken by cracks that caused displacements amounting to thousands of feet, producing what the geologist terms faults. In other places, where the disturbance was less, hot solutions, probably connected with the intrusion of the granitic rock, deposited the ores, partly as fillings of open cracks but largely as replacements of the adjacent rock by chemical processes. After the intrusion of the granite and the formation of the deposits of ore, an uneven layer of rock, probably some thousands of feet in thickness, was gradually removed by the action of weather and streams. This erosion exposed the once deeply buried granite and the ore. The principal mineral of the lead-silver ores is galena (sulphide of lead), which in this district invariably contains some silver. Other common minerals of metallic luster associated with the galena are pyrite (sulphide of iron), pyrrhotite (magnetic sulphide of iron), chalcopyrite (sulphide of copper and iron), and sphalerite (sulphide of zinc). The characteristic waste mineral of non-metallic luster associated with galena, that is, the gangue of the ore, is siderite (carbonate of iron). The ores, as mined, carry, as a rule, from 5 to 50% of lead, and from 3 to 45 oz. of silver to the ton. All but the highest grades are concentrated in the district, by milling, to a product containing about 50% of lead and from 15 to 55 oz. of silver to the ton.

The departments at Washington receive annually 43,000,000 communications and dispatch 22,000,000—a total of 65,000,000 in a year. Twenty-five million of these are filed at a cost of $260,000, or about a cent per document. The expense of filing varies from $6.53 per thousand in the Post Office Department to $20.53 in the Department of the Interior.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Ratio of return to initial feed of tube-mills at the Tonopah-Belmont mill is 0.91 to 1, or total feed 127.38 tons, initial feed 67.18, and return feed 60.20 tons.

Zinc in cyanide solutions from precipitation sometimes combines to some extent with the sulphur in them, similarly to the lead in lead acetate to treatment solutions.

Smoke combustion or smoke burning are not considered good terms in the discussion of furnace firing. When once made, lamp-black is incombustible and cannot be burned.

West African mining companies have had short lives. Of 260 companies formed in 1901 only 20 were alive in 1911, and of these but five or six have paid dividends, and only one company has done really well.

Money has not always consisted of gold, silver, and copper but various other substances have been used among which may be mentioned cattle, rice, cacao, oil, rock-salt, wampum, tobacco, brick, tea, dates, beans, sealskins, sables.

Labels may be paraffined by dissolving paraffin in CCl_4, and using a saturated solution as a varnish. To prevent the adherence of drops of liquid to the inner surface of volumetric vessels, coating them with a layer of pure paraffin has been successfully tried.

Corundum is for the most part a pyrogenic and primary mineral occurring in aluminous rocks of syenitic and gabbroic type. These are not confined to one locality, but have been recognized and fully described in Russia, India, California, Montana, Colorado, and Ontario.

Unique mining methods were seen by the *bachelier* Martin Fernando de Encisco in 1510, when, so it is related, he saw the natives in the Province of Zeno, east of the Gulf of Darien, catching in nets the coarser particles of gold, that were brought down by the mountain torrents.

Sulphocyanide amounting to about 2.7 lb. is carried in solutions at the Tonopah-Belmont mill. While this cyanide combination does not hinder the dissolution of gold and silver—except in so far as this or any inert salt tends to increase the viscosity of the solutions—still it is a combination of cyanide that it is almost impossible to break up, and must therefore be considered as a part of the cyanide consumption.

Zinc is a highly crystalline metal, and its tensile and transverse strength depend entirely on the size of the crystals. The tensile strength varies from about 2 tons per sq. in. with coarse crystals, to 7 tons with very fine-grained ones. The transverse strength also varies with the crystallization, being greater the finer the grain. The modulus of rupture is from 4 to 11 tons per square inch.

Sulphur and yellow fever are not usually thought of together, but it was the employment of 300 tons of sulphur and 120 tons of insect powder, the entire supply of the United States, that enabled Gen. Gorgas to destroy the mosquitos in Panama and so thoroughly eradicate yellow fever that no case has occurred since May 1906. Before the use of sulphur and other sanitary measures the annual death-rate from yellow fever expected, on the basis of the French ratio, was 3500. The death-rate per 1000 during the French occupation was 200 per 1000. In ten years of the American control the rate was 17 per thousand.

With reference to the power of the state and county to tax unpatented mining claims, we can do no better than to quote from a decision of the U. S. Supreme Court (Elder *v.* Wood, 208 U. S., 226-232): "* * * Such an interest from early times has been held to be property distinct from the land itself, vendable, inheritable, and taxable. [Cases cited.] The State therefore had the power to tax this interest in the mining claim and enforce the collection of the tax by sale. The tax deed conveyed merely the right of possession and affected no interest of the United States." It will thus be seen that this power to tax unpatented mining claims is unquestioned. The purchaser at such tax-sale merely succeeds to the possessory title owned by the tax-delinquent and of course has to comply with all the conditons of the mining laws. He merely steps into the shoes of the locator.

Contact-deposits originate through the action of volcanic magma at a high temperature, especially when under pressure and the contained fluids and gases have no chance to escape into the atmosphere. The deposits are therefore essentially the product of intrusion. The zone thus subjected to metamorphism, and of which the outer border keeps more or less parallel to that of the intrusion, is termed the contact-zone. In it the ore deposits are usually concentrated in the immediate neighborhood of the intrusive, or not far from it. Close to the actual contact of this rock with that through which it was forced, fragments of the latter are often found imbedded with the ore in the intrusive. These occurrences are usually the result of the alteration of limestone to oxide or sulphide ores. Where earthy limestone originally existed the calcareous constituents become altered to white crystalline marble, while the argillaceous material crystallizes as garnet, vesuvianite, scapolite, augite, hornblende, epidote, etc. It is generally accepted that such a re-crystallization is brought about by hot solutions or steam escaping from the magma. It must be pointed out that the expression 'contact-deposit' is unfortunately even today applied a good deal to occurrences having nothing to do with contact phenomena, but which by chance occur along the plane where two rocks come in contact. This wrong use of the term should in all reason be avoided.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LONDON

TANGANYIKA CONCESSIONS.—UNION MINIÉRE DU HAUT KATANGA OPERATIONS.

In many ways the position of the Tanganyika Concessions and the Union Miniére du Haut Katanga at the present time is of unusual interest. In spite of the Union Miniére offices being in Brussels, and the directors and shareholders scattered, it has been possible to house some of the staff at the Tanganyika offices in London, and to continue development of the great copper enterprise in the Belgian Congo. The Tanganyika was formed 16 years ago by Robert Williams to acquire concessions in northern Rhodesia from the British South Africa Co., and has through a subsidiary, the Rhodesia-Katanga Junction Railway & Mineral Co., done much to open communications with the south and to develop copper deposits

MAP SHOWING SITUATION OF TANGANYIKA CONCESSIONS.

at Kansanshi. But by far the most important work has been in connection with the great copper belt in the Katanga territory of the Belgian Congo State, just over the Northern Rhodesian border. A 40% interest was acquired in a Belgian company called the Union Miniére du Haut Katanga, formed to acquire the territory, the remaining 60% being held in Belgium. The technical control has been with the Tanganyika company, and the development of the deposits and the metallurgical treatment have been under the direction of Mr. Williams and his staff of engineers and metallurgists. The surface extent of the copper deposits caused the usual unwarranted boom in the Tanganyika shares six years ago, but, as pioneers of empire, we mining engineers must not blame the directorate of the Tanganyika Concessions for the rosy reports circulated in those days, or for the subsequent fall in the shares when the real business commenced. In addition to the development of the copper deposits, it became necessary to find an outlet to the west coast of Africa, and so avoid the long railway haul to Beira on the east coast or to Cape Town, and to shorten the sea journey to England. The energy of Mr. Williams was with this object in view, devoted to the building of a railway from Benguella on Lobito Bay in Portuguese West Africa, to Katanga. This work is being done through the agency of a Portuguese company, the Benguella Railway Co., the capital of which has been supplied by the Tanganyika company. The railway has been built from the coast inland for 322 miles, and the local traffic is sufficient already to yield a profit. One thousand miles of rails have yet to be laid before connection is made with Katanga, and under present conditions it is obvious that further progress must be slow. In the meantime the copper produced has to be shipped by way of Victoria Falls to Beira. Perhaps a short cut on this route may before long be provided by means of a connecting line from Salisbury to the Rhodesia Broken Hill. The copper belt of the Katanga extends for 200 miles, and many surface workings have exposed large amounts of ore. The ore is all oxidized, and in the absence of technical details much debate has taken place in London and elsewhere as to its exact genetic nature. So far, investigation at depth by drilling has not proved the existence of bodies of sulphide. There is no need to worry about this, for the estimated reserve at the various workings totals 40,000,000 tons averaging 8% copper, with indications by shallow drilling of continuation of similar ore in depth. Smelting commenced in 1911, when 997 tons of copper was produced. The figures of copper production for 1912, 1913, and 1914 were 2492 tons, 7407 tons, and 10,722 tons respectively. Additional blast-furnaces are being built, and the output for 1916 will be about 25,000 tons. The Star of the Congo, the Kambove, and the Luushia mines are the chief producers, and their total proved reserves are estimated at 6,000,000 tons, of which 1,200,000 tons is smelting ore averaging 15% copper. From the other 4,800,000 tons it is estimated that about 25% can be concentrated so as to yield 400,000 tons averaging 18% copper. The remaining 4,400,000 tons of ore will assay 6% copper, and plans are now in hand for concentrating this. During 1914, the smelters treated 92,381 tons of ore, for a yield of 10,722 tons of copper. The working cost at the smelter is estimated at £29 12s. 10d. ($142.28) per ton of copper. Owing to the disorganization of the Union Miniére office, no accounts can be presented, and the Tanganyika, which depends on the Union Miniére for its income, is in the same position. The Tanganyika debenture interest cannot be paid for this reason, and the courts have sanctioned the postponement of payment until after the close of the War. The Tanganyika enterprise, in the heart of Africa, may appear to be of little interest to Americans, but American mining men and metallurgists have been, and are, of substantial service. We must not forget the old Californian, John R. Farrell, who served the Tanganyika well in the early days and demonstrated the extent of the deposits. More recently the services of A. E. Wheeler, of Montana, have been requisitioned and he has in hand the construction of the new blast-furnaces. An American who was consulted in connection with the smelting problem six years ago was Walter G. Perkins. For some reason or other differences of opinion arose almost at once between Mr. Perkins and the staff, and the benefit of his experience was unfortunately lost to the company in consequence. It is clear therefore that the future of the Katanga copper enterprise will be of interest to both English and Americans.

CRIPPLE CREEK, COLORADO

Rain Delays Surface Work.—Portland Operations.—Elkton Water-Level and Lessees.—Blue Bird.—Kavanaugh and Gaylord Mills.

The past week has been a very quiet one in mining circles here. The recent heavy rains have greatly interfered with surface work. Rain apparently is nearly over, and production from dump leases should soon increase. Several of the small local mills which have been shut down are again treating low-grade ores.

The Portland company is cutting a station on No. 18 level at No. 1 shaft. This will make the level about 1850 ft. below the collar. At the Portland-Independence property the storage-battery locomotive is busy hauling ore from the adit to the mill. This material is obtained from the workings above the adit level, and from the surface.

At a recent directors' meeting of the Elkton Consolidated company Jas. F. Burns gave in his resignation as a director. No one was elected to fill the vacancy. Company work at the Elkton is rather limited at present. The water-level has not receeded sufficiently to allow of much being done. The shaft is nearly 300 ft. above the level of the Roosevelt drainage-tunnel. It is expected that in six months' time the adit will be past the Elkton shaft, and the water will be drained to the tunnel-level. At present there are about 50 sets of lessees at the property, and these will continue to work as usual. During the past week a second shift has commenced work in the drainage-tunnel, so that the footage will be at least doubled.

At the Blue Bird property on Bull hill the leasing company is showing considerable activity. No sub-lessees are working. It is the intention of the company controlling operations to open large quantities of medium and low-grade ores. In this way the modern mill, which is to be erected on the property in the near future, may be kept working at full capacity.

The Kavanaugh mill on the Jo Dandy property, and the Gaylord mill on the Dante, are again at full capacity. These mills have been shut down for several weeks. During this time the machinery has been thoroughly overhauled, and everything put in shape for steady operation.

GOLDFIELD, NEVADA

Operations of the Pioneer Consolidated: Development, Mill, Low Costs.

In the Pioneer district, 55 miles south of Goldfield, the Pioneer Consolidated Mines Co. has just increased the operating time of its 10-stamp mill from 12 to 16 hours per day. Heretofore the plant has been treating about 30 tons in 10 or 12 hours, and when operated full time it is said there will be no difficulty in treating 75 tons per day. J. K. Turner, of the Jumbo Extension Mining Co., is consulting engineer for the Pioneer Consolidated. He has lately sampled the newer workings of the mine with satisfactory results. On December 24, 1914, a cave-in occurred in the main stope, known as the Bonanza stope, while it was being examined by W. J. Tobin, president and general manager, and he and a miner were seriously injured. Thereupon the mine was closed and only resumed, on Mr. Tobin's return, early in July last. The Bonanza stope produced upward of $200,000 worth of high-grade shipping ore some 10 years ago, and recent development near the walls has revealed a large tonnage of good mill ore, together with some ore of shipping grade. Mr. Turner took samples at the point of the cave-in, on the 150-ft. level, across 5 ft. and for a distance of 20 ft., averaging $26 per ton. Three samples from the east side of this stope, across 5 ft., averaged $16.13 per ton. A sample from near the top of the No. 9 chute, across 5 ft., yielded $12.80 per ton. Five samples from the west side of the stope, on the 130-ft. level, each across 10 ft., averaged $14.32 per ton. One sample at the west side, on the 140-ft. level, across 5 ft., and for a distance of 15 ft., gave $16.60 per ton. A sample at the northeast end of the stope, on the 170-ft. level, across 5 ft. and for 15 ft. in length, yielded $13.20 per ton. The assays are all gold, there being no other metal present, and all the ore is free-milling. Recovery in the mill is entirely by amalgamation, and with new screens and re-silvered plate for the Huntington mill it is expected that an extraction of at least 80% will be effected. The ore is crushed to 1½ in. and fed to the batteries by automatic feeders. Amalgamation is done in the batteries, on sets of 6-ft. plates below them, then in the 5-ft. Huntington mill, and on 12-ft. plates below the Huntington. The ore passes through a 6-mesh screen in the mortars and 40-mesh at the Huntington. The orebodies are of uniformly large size, and a single man breaks sufficient ore for the mill and trams this quantity to the cages. At the surface, one man trams the ore to the mill-bins, and attends to the crusher and feeding; one man operates the electric hoisting engine and does all blacksmithing, and one man operates the mill. The entire force, including manager, comprises 11 men. Total operating costs are less than $3 per ton. The amalgam is retorted in the company's assay-office and shipped in the form of bullion to the mint. A promising discovery has been made lately at the surface, about 400 ft. northwest of the main shaft and near the old Rickard lease shaft, operated several years ago by "Tex" Rickard. A body of quartz is exposed, from which good pannings are obtained, and development is in progress at this point. The main orebody has lately been exposed in a raise from the 256-ft. level, southwest of the Bonanza stope. The recent sampling shows approximately 1000 tons of good mill ore broken in the mine. At Mr. Turner's advice, Mr. Tobin is starting a large amount of new development work, on all levels. The Bonanza stope, which is over 20 ft. wide in places, has been completely timbered with square-sets. A station is being cut at the 75-ft. level of the Rickard shaft, which is equipped with a good hoist. A cross-cut will be driven to the lode recently found at the surface. The collar of this shaft is 160 ft. higher than that of the main shaft. Work will be started at several other points in the district within the next month.

ELY, NEVADA

Nevada Consolidated Operations.—Tungsten Production.—Gold and Zinc.

The Nevada Consolidated Copper Company is operating at full capacity. New machinery for additional electric power has not yet been received. The manufacturers are paying a penalty of $25 per day and are too busy making war munitions. It has been thought for some time that the company was short of dumping space. The Coppermines company had the Nevada Consolidated surrounded, and the latter could get no more depth in the Eureka pit. The Nevada Consolidated is widening the railroad right-of-way, south of the depot, at Copper Flat, and also the entrance to Eureka pit. This will enable the company to lay the main line over to the east of its right-of-way, and leave plenty of space to cut down along side, commencing back 1000 ft., and make a much better grade into Eureka pit than now and enable deeper work there. The company has acquired from Dick Reipe the old townsite of Junction City, about three miles below the pit, 140 acres of patented ground, which is 125 ft. below the depot level. Double tracks are being laid and will be used for overburden, giving sufficeint area for a long time. This is a down-hill haul, loaded, against a heavy up-grade to the present dumps, which will largely compensate for the additional length of haul.

The U. S. Tungsten Co., just south of Osceola, this county, has for some time been working its mine and mill with about 25 men, and turning out about 800 lb. of about 60% concentrate, which is hübnerite. Development on the vein at 600 ft. shows about the same conditions as near the surface, namely, high-grade shoots or lenses of ore.

Some San Francisco people are mining and shipping scheel-

ite from Sacramento pass, two miles north of Osceola. They are erecting a mill on John Tilford's scheelite claim, in Snake creek, above Garrison, having a contract for the ores. They are investigating the country for scheelite.

A. R. Shepherd has taken a bond and lease on the Sims-Olsen hübnerite property in the north end of Spring valley in the northeast corner of this county and will soon commence work. There is a vein 13 to 20 ft. wide in granite, with fine walls and slickensides, and can be traced about 3000 ft. on the surface. There are also three other parallel veins, all with shearing-planes, from 2 to 5 ft. wide.——The Red Hills lead mine, not far from the Sims-Olsen, is being worked, having recently shipped a carload of ore.

At Willow Creek, southeast of Ely 100 miles, in Nye county, but tributary to Ely, Salt Lake men have recently become interested in the Willow Creek Consolidated Gold Mining Co., having an option on a majority of the shares. Development has been started. One vein has recently been opened, and at shallow depths for several hundred feet in length shows considerable free gold.

The Mud Springs lead mine, 25 miles from Currie, is being worked by Mr. Morrison.——Woodward and sons and others of Salt Lake City are shipping considerable calamine from the Polar Star mines in the northwest part of Clover valley. ——Other people are shipping a zinc concentrate and lead concentrate from Shorts zinc mine, on the west side of Ruby valley.——The Giroux Consolidated copper mines at Ely appear to be dead, nothing having been done for over a year.

JOPLIN, MISSOURI

Zinc Prices Again Strong After Temporary Decline.—Large Deals.—Development in West Joplin District.

Zinc-blende prices, which were quoted at $80 to $110 per ton, basis of 60% metallic zinc, at the beginning of August, declined to $50 to $70 at the close of the month; but the first week of September saw bids suddenly advancing to $75 and $90, this being the quickest advance in the history of the local industry. In a single week calamine, which had sold for as low as $35 per ton, rose to $70. The cause of the changed conditions is doubtless due to the manipulation of the spelter market which, from a high level of $26 per cwt., paid several months ago, had dropped to $11. While metal prices were at this low point, relatively speaking concentrate likewise declined to a figure which seemed low when compared with the high prices that had prevailed. Buying was heavy during the week or two that prices were so low. Spelter has now gone to $16 per cwt., which, judging from conditions, is abnormally high. Throughout the Missouri-Kansas-Oklahoma district there was a general feeling that the lower prices would remain, the result being that a number of large mines were shut down, and many large operators were on the point of discontinuing production when the sudden change for higher prices came about. The temporary handicap that was given to new development has now been partly overcome, and much important work is under way.

Mining deals of importance have been features of the past few days. The Athletic Mining Co., of Webb City, Missouri, of which C. T. Orr is general manager, purchased from A. W. and W. A. Van Haften the Gopher mill and lease at Duenweg, Missouri, for $70,000. This mine is now being operated under the name of the Athletic Mining Co. No. 2. The property was opened several years ago by the Lincoln Mining Co., and later taken over by the Van Haften Co. While it has been a steady producer, profits have not been large, due to the fact that during the greater part of the time the mine was worked, metal prices were low. Within recent months, however, the property was making good profits. Sheet-ore was worked at a depth of 240 ft. The purchase price included the 500-ton mill, and a first lease on 40 acres of the Jasper County Royalty Co.'s land. In addition to this 40-acre tract the Athletic company had already acquired an adjoining lease on 120 acres, on which the old Wolfsheart and San Gabriel mines were situated. The company contemplates the erection of one or two concentrating-plants on this property.

Another mining deal was the sale of the La Nora B mine by G. Bayless and associates to L. L. Hutchinson and others of the Glenn Pool oil district, Oklahoma, for $30,000 cash. This pays for the lease on the mill, which is of 300-ton capacity, and first lease on 52 acres of the Higgins Land & Mining Co.'s property, one mile west of the city limits of Joplin. Bayless took over the La Nora B mine 10 months ago. Formerly it was worked under the name of the Martha Ball, and was not a steady producer. Deeper and more extensive work done by the new company places the La Nora B in the front ranks of the big West Joplin producers. Mining is under way at a depth of 170 ft. in thin sheet-ore formation, the extent of which has been shown by a great many drill-holes. The work of the La Nora B has been confined to 25 acres of the 52-acre tract. On the remaining 27 acres some recent prospecting has shown a continuation of the sheet orebody. The new company, for which Mr. Bayless will act as manager, contemplates the construction of a 500-ton concentrating-plant.

A group of three new mills is to be found in the West Joplin district, while a fourth has only recently begun operations, thus making this one of the busiest parts of the district. The new plants are the S. Y. Ramage No. 8 and the Once More, both of which are nearing completion; the Gibson Mining Co.'s plant, which is just beginning to produce concentrate; and the A. W. C. Mining Co.'s mill No. 4, which began production about two months ago. The Ramage mill is on a 40-acre lease of the Deering Land & Leasing Co.'s property, one mile west of the city limits of Joplin, and is one of the largest, most modern plants in the entire district, having a capacity of 500 tons per 10-hour shift. The frame is built of structural iron, concrete, and galvanized iron. Gas engines will be used to operate the mill machinery and compressors. Some distance to the east of the mill is a separate unit for the treatment of sludge. This building is as substantially built as is the mill proper, and is equipped with 10 tables. Electric power will be used in the operation of the tables. The Once More mill is on a lease of the Old Hackett Mining Co.'s tract, and a well-built frame mill is nearing completion. On the same ground, but some distance to the northwest, is the new plant of the Gibson Mining Co. This company is working in the old ground formerly mined unsuccessfully by the Hackett Mining Co. An extremely thin, but extensive, sheet-ground formation is encountered at this point, and the new company apparently is making a success out of its venture. The new mill of the A. W. C. company makes the third to be worked by that company. This group is about ¼ mile south of the Ramage, Once More, and Gibson plants. The A. W. C. company's three mills combined make a large weekly production of high-grade concentrate. The average depth of the workings in the West Joplin field is 160 to 170 feet.

A hurry-up job of mill construction is under way at the new plant of E. R. McClelland and J. W. Perry, of Kansas City, who have a lease on 40 acres of the Colclasure land at Porto Rico, Missouri, eight miles northeast of Joplin. They have the ground on which the American Beauty Mining Co. operated five years ago. Sheet-ore is cut at a depth of 200 ft., into which orebody two shafts have been sunk. The mill, costing $37,000, is entirely new. It will be driven by gas-engines and will have a capacity of 350 tons per shift.

C. Clarke and associates of Kansas City, who purchased, through C. W. Edwards, the Spurgeon-Tiger mine on a lease of the Wills & Bucklen land at Spurgeon, 10 miles south of Joplin, are spending $25,000 in re-modeling the mill and installing an up-to-date sludge department. They have three shafts into disseminated ore at a depth of 55 feet.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

JUNEAU

The first gold mining in Alaska was in the Juneau district, where operations were begun about 35 years ago. More than $60,000,000 worth of gold has been produced from this area, most of it from the mines near Juneau, which is the most important centre in the Territory. The auriferous belt is, however, known to stretch for about 50 miles to the north and includes the Eagle River region, described in a report by Adolph Knopf, which has been issued by the U. S. Geological Survey as Bulletin 502. This report, unlike many others on mining districts in Alaska, which are of a reconnaissance character, treats of the region in detail. It is entitled 'Geology and Mineral Resources of the Eagle River Region, Alaska,' and is accompanied by a topographic map on a scale of a mile to the inch, with 100-ft. contours, by J. W. Bagley, and a detailed geologic map on the same scale.

The Juneau district was recently visited by Sanford Makeever, who is largely interested in the Alaska Gold Belt property, which is being developed by A. B. Dodd. Mr. Makeever states that it is perhaps not generally known to others than mining engineers that by approaching the upper Sheep Creek district from Grindstone creek it is possible at this time of year, or at a time when there is no snow, to view practically a cross-section of the whole geological formation of the district which comprises the properties of the Alaska Gastineau, Alaska Juneau, and Alaska Gold Belt properties. There are four distinct gold areas near Juneau. The first is the Silver Queen, which ends about where the old sawmill is situated a little below Thane; the second might be called the Perseverance; the third is larger than all of the others combined, but has no name; the Alaska Gold Belt is the fourth area. Its adit will cut the third belt at a depth of about 1200 ft., and, by sinking, a depth of 3300 ft. through both veins will be gained. The Alaska Gold Belt property covers a total of 2690 acres. When the present adit has proved certain orebodies, a 9000-ft. adit, two tracks wide, will be started. At the mill-site 1400-hp. can be developed, there being a 1200-ft. head on Little Sheep creek. A large mill, houses, wharves, and other equipment is to be erected during the next year. A total of about $3,000,000 is to be spent in bringing the property to the producing stage.

VIEW OF THE JUNEAU DISTRICT, ALASKA.

ARIZONA

The itinerary of U. S. Bureau of Mines rescue-car No. 2, in charge of J. H. East, is as follows: Bisbee, September 5 to 7; Clifton, September 7 to 9; Globe, September 9 to 11; Los Angeles, California, September 12 and 13; and San Francisco, September 14.

GILA COUNTY

The Globe-Miami region is in an active and prosperous condition. Many lessees are working, and prospects are shipping ore, in addition to operations at the Old Dominion, Gibson, Arizona Commercial, Iron Cap, Miami, and Inspiration. Three furnaces at the O. D. are producing 50 tons of copper daily, the mill is concentrating 600 tons per day, and the mine output of ore is between 900 and 1000 tons. About 6,500,000 gal. of water is pumped daily. A number of installations are being completed on the surface. Over 10 ft. of high-grade ore has been opened at 1400 ft. in the A. C. mine, the full width not being known yet. No. 10, 12, 13, and 14 levels are active points. There are 120 men employed. The Inspiration Needles Co. has purchased the Prospectors' claims, near the Southwestern Miami. Surface indications of the Inspiration Needles ground are good.

MOHAVE COUNTY

Shareholders of the Union Basin Mining Co., which operates the Golconda zinc mine, 16 miles north of Kingman, received a dividend of $85,000 last week. This is equal to 10% on the issued capital. The daily output of high-grade ore is about 100 tons, mostly from 800 ft. depth.

CALIFORNIA

Final figures of the gold yield of this State in 1914 have been prepared by Charles G. Yale of the U. S. Geological Survey. The total was $20,563,496, the largest output, save 1883, since 1864. The number of metal producing mines was 658, of which 340 were placers that yielded gold and silver valued at $9,100,136. This output from placer mining was $242,590 more in 1914 than in 1913, and was exceeded in 1914 only by that from Alaska. The placers produced 44% of the output of gold from California in 1914, and the 60 gold dredges operated produced 86% of the placer gold and 38% of the gold derived from all sources. The gold recovered by dredging amounted to

$7,783,394, of which the field near Marysville, Yuba county, produced $2,755,734; that near Oroville, Butte county, $1,637,515; and that near Folsom, Sacramento county, $2,161,653. Dredges, operated in Calaveras, Merced, Placer, Shasta, Siskiyou, Stanislaus, and Trinity counties, recovered $1,228,502. Dredge mining was first started in California in 1896 and the total quantity of gold recovered by that method of mining up to the end of 1914 was $71,307,766.

The largest gold-producing centres were Grass Valley (including Nevada City), in Nevada county, where the deep mines yielded $2,997,405 in gold and $25,868 in silver, and the Jackson-Sutter Creek district, where the deep-mine production was $2,113,098 in gold $12,674 in silver.

Nevada county, which produced the most gold, had a yield of $3,301,948, or $383,215 more than in 1913. Other counties that produced over $1,000,000 in gold were Amador, Yuba, Sacramento, Butte, Calaveras, and Shasta.

The total value of the mine output of gold, silver, copper, lead, and zinc was $25,710,645, so that the value of the gold recovered amounted to 80% of the total value of the five metals. The mine productiou of copper was 30,507,692 lb., valued at $4,057,523; silver, 1,471,859 oz., $813,839; lead, 4,251,923 lb., $165,825; and zinc, 389,471 lb., $19,863. The total quantity of ore sold or treated in 1914 was 2,465,485 tons, and the average value per ton of all metals recovered was $6.74. Of the ore treated, 2,050,3337 tons was silicious gold ore, from which there was an average recovery of $5.25 per ton in gold and silver. There was 1,993,821 tons of ore treated at gold and silver mills, which yielded $10,743,207 gold and $91,327 silver, or an average value of $5.44 per ton. Ore smelted amounted to 449,132 tons, of which 397,868 tons was copper ore, 640 tons lead ore, and 16,180 silver-lead ore. This smelting ore yielded metals valued at $5,633,856, or an average of $12.54 per ton.

Shasta county was the largest producer of copper, with an output of 25,198,669 lb., and it also made the largest production of silver, 626,954 oz. Inyo county supplied all the zinc, and 4,205,154 lb. of lead out of a total State production of 4,251,923 lb. The most productive metal centre in the State was at Kennett, in Shasta county. From the mines at and near Kennett there were recovered metals valued at $3,087,279, of which $2,411,323 was for copper.

Oil production of the State in July totaled 7,738,643 bbl., an increase, according to the Independent Oil Producers' Agency. Ten rigs were completed, 132 wells were drilling, 36 wells were completed, 19 wells were abandoned, and 6083 were producing.

In view of the great interest manifested by first-aid teams from mining colleges in the third annual joint field meet to be held by the U. S. Bureau of Mines, the American Mine Safety Association, and the California Metal Producers' Association in San Francisco, September 23 and 24, the rules committee has withdrawn the restrictions against the participation of such teams in the meet. The ruling previously made that only teams from bona fide mining, smelting, and milling operations should be admitted to the interstate contests of September 24, thereby restricting teams from mining colleges to participation in the demonstrations of September 23, has been modified to provide that such teams and teams from state departments or other institutions interested in safety in mining, but not concerned in mine operation, may compete among themselves on the 24th for a special prize for the most proficient team from an educational institution. It is hoped that a special prize or cup may be offered as an award to the team winning in this special competition. It is believed that this modification of the rules governing the meet will result in the sending of a good number of teams from the various colleges and universities in the West.

Eldorado County

Sampling of the Georgia Slide mine is in progress for New York people. M. L. Hurley is in charge of the work.——At Clarksville, in the extreme west of the county, G. S. Miliken of Sacramento is developing a rich prospect. A two-stamp mill has been erected to crush the ore.——The Stillwagon mine, southwest of Placerville, is being re-opened by G. Willis. The property has produced a good deal of gold, being opened by a 790-ft. adit and other workings. A five-stamp mill and general equipment is being overhauled.

Inyo County

(Special Correspondence.)—The Skidoo Mines Co. has been operating 15 stamps with considerable difficulty. The 24-mile pipe-line, which serves for both power and water-supply, developed many weaknesses during the hot weather. The company is considering installation of a 40-hp. gas-engine for auxiliary power.——A. Murphy, Jr., lease on the Cashier mine at Harrisburg will be closed in a few weeks. All the ore appears to have been extracted.——The antimony mine at Wild Rose is keeping five 2½-ton motor trucks busy hauling ore to Trona. The tonnage was recently increased by the addition of a Renard train, originally imported from England by the American Trona Co. The train made the first 45-mile trip successfully with 15 tons. The antimony occurs as stibnite in lenses scattered over eight claims. The ore is high grade, and remarkably free from gangue minerals. The gossan minerals are senarmontite and cervantite. The small smelter in which the sulphide ores were treated was a failure, the building now being used for a machine-shop.——A small quantity of zinc ore is being hauled to Trona from the old Minietta mine, which adjoins the Modoc of Haggin fame.

Skidoo, August 24.

The Cerro Gordo mine is employing over 140 men and producing about 140 tons of zinc ore daily, in charge of Louis D. Gordon. A total of 1681 tons of ore was mined from the 200, 400, and 500-ft. levels during March, April, May, and June. This contained 1,109,481 lb. zinc. The mine has been opened to 1200 ft. depth. Of importance to the district is the Troeger adit, which has been driven over 6000 ft. to cut the veins in Cerro Gordo hill. A high-grade silver-lead vein has been cut, also several containing copper and gold. The adit is being extended.

Placer County

The Dewey Consolidated gravel mine, adjoining the Morning Star, at Iowa Hill, is being developed by J. P. Keene.

Plumas County

The Plumas Eureka Mines Co. of Johnsville is bankrupt with $133,634 liabilities and $41,515 assets.

Tuolumne County

(Special Correspondence.)—From the clean-up of 15 stamps for the last half of July, the Nyman Consolidated company shipped two bars of gold-bullion weighing 251 oz. One bar is from the Knox & Boyle claim, which is being worked by lessees. About three months time has been spent in unwatering the Knox & Boyle shaft, and in making repairs to the track and clearing portions of the deeper development after remaining dormant for about 15 years. The shaft has been opened to the 800-ft. level, but at 700 ft. a good orebody was found showing 4 to 6 ft. This ore has averaged about $10 per ton recovery in the last month, and with the entire south face of the stope between the 700 and 600-ft. levels in good milling ore, the lease should prove profitable. Twenty-five per cent royalty is paid, plus $1 per ton for milling by the company. Work is being carried on in two shifts, with four machines in operation in the stopes. The second bar is from a short mill run on the Mascot ores now being mined on the 200 and 250-ft. levels of the East vein in the Miller & Holmes claim, and comes from the ores left in the stopes by the 'gopher-holers' last in operation, and now necessary to remove before any practical mining is possible. This ore so far extracted has shown to the management that a good return could be secured from its treatment in the mill, and over 500 tons have been sent to the mill to date.

Jamestown, August 9.

IDAHO

Elmore County

The Rocky Bar property, in the district of that name, is being worked by W. D. Ebbert, of Salt Lake City. He contemplates erecting a 100-ton mill. The mine is opened by adits.

Shoshone County (Coeur d'Alene)

Dividends paid in eight months of 1915 are as follows:

Company	August	8 months
Bunker Hill & Sullivan	$ 81,750	$ 654,000
Caledonia	78,150	468,900
Federal	.....	240,000
Hecla	70,000	180,000
Hercules	.....	1,000,000
Interstate-Callahan	920,000	1,610,000
Stewart	.....	681,098
Success	120,000	285,000
Total	$1,269,900	$5,118,098

On September 4 the Bunker Hill & Sullivan company will pay dividend No. 215, amounting to $81,750. This makes a total of $16,446,000.

The Black Bear Consolidated Mining Co., which has been developing the Black Bear mine, near Gem, has been absorbed by the Rex Consolidated Mining Co., recently organized to take over the Rex mine, in the Nine Mile district of the Coeur d'Alene.——A report made on its mine by C. F. O. Merriam has been published by the Nabob Mining Co. The main adit is in 1964 ft., and a total of 3037 ft. of development has been done. The engineer recommends that the ore exposed (20,000 tons) in the upper workings and in the lower adit be further developed. This can be done without any extensive work, a total of about 1405 ft. Electric power and a larger compressor are necessary. Development should then be about $14 per foot.

Owyhee County

The Chicago Nitrate Co. has reduced its force to seven, while waiting the result of pending suits to determine whether the claims must be located as quartz or placer. Most of them were located as quartz claims.

MICHIGAN

The Copper Country

During the half-year ended June 30, 1915, the Quincy Mining Co. paid $666,250 in dividends and for land purchased, $226,250 being paid the Hancock company under an agreement several months ago. This gives the Quincy important privileges. In 10 years the Quincy company has paid $1,746,250 for land acquired.

Seventy feet of the No. 2 shaft of the Centennial, which was burned two weeks ago, is to be re-timbered. When the skip dropped, it tore out a good deal of timber lower down. Most of the wood on the rock-house will have to be replaced. Breakers and shafting were little damaged.

Isle Royale is shipping from 2500 to 2700 tons of ore daily to the mills; Mass is producing about 1200 tons per day; and Superior about 500 tons.——South Lake will soon be able to send over 400 tons per day to the Franklin mill.——Over 250 men are working at the Lake.——The Ahmeek output is over 2800 tons per day, also a good deal of mass copper.——It is reported that tailing from the White Pine mill contains 12 to 15 lb. copper per ton, so they are being stored for future treatment. Transport of 'mineral' (concentrate) from the mill to the C. & A. smelter at Hubbell is difficult and expensive. No. 4 shaft is down 912 feet.

As the Copper Range subsidiary companies each pay Federal income-tax, a total of 3% on the gross income, all the companies are to be consolidated, the Copper Range having increased its capital from $2,500,000 to $10,000,000, divided into 400,000 shares at $25 each.

MISSOURI

Jasper County

Low prices and rain interfered with good returns in the Missouri-Kansas-Oklahoma district last week. The output was as follows: Blende, 4846; calamine, 284; and lead, 944 tons, averaging $50.72, $38.54, and $43.84 per ton. The total value was $298,498, and for 34 weeks, $14,852,149.

MONTANA

Silverbow County

At the Anaconda mine, a concrete building to contain mine-rescue and fire-fighting apparatus, also to serve as quarters for training in rescue and first-aid, is being constructed. The Leonard and Original mines' first-aid teams will compete at Butte on Labor Day for the honor of representing the district at the contests at San Francisco in two weeks' time.

At 2500 ft. in the Davis-Daly the southwest cross-cut has cut No. 1 branch of the Hesperus vein.——An option has been acquired by the East Butte company on 18 acres of the Largey estate adjoining the Davis-Daly for $200,000.

NEVADA

The production of gold, silver, copper, lead, and zinc from Nevada ores sold or treated in 1914, according to Victor C. Heikes, of the U. S. Geological Survey, was valued at $29,300,842. Details are as follows:

Gold, ounces	555,402
Silver, ounces	15,455,491
Copper, pounds	60,986,450
Lead, pounds	12,809,655
Zinc, pounds	12,980,232

There were 731 producers of these metals during the year. Of the total of 4,522,022 short tons of ore sold or treated, 1,461,577 tons was treated in gold and silver mills, principally cyanide; 2,768,193 tons was concentrated, largely copper ore; and 261,018 tons represented crude ore that was shipped to several smelters. The largest part of the total tonnage, or 2,882,121 tons, represented copper ore; 1,594,486 tons was silicious ore; 16,088 tons lead ore; 9490 tons zinc ore; 3762 tons copper-lead ore; and 16,075 tons lead-zinc ore.

Esmeralda County

A Cameron motor-driven pump of 150-gal. capacity per minute has been ordered by the goldfield Great Bend company. This will be installed at 400 ft. The present flow of water is 75,000 gal. per day, but it has been as high as 200,000 gal.——Final figures of July operations at the Goldfield Consolidated are as follows: mine development, 2557 ft., at $5.97 per foot; ore treated, 33,388 tons, realizing $105,292 net; net costs, $4.91 per ton; and lessees' production, 1588 tons with a gross value of $45,436, from which the company received $17,962, less the cost of milling and transportation. On October 31 a dividend of 10c. per share will be paid.

Humboldt County

(Special Correspondence.)—A hoist, pump, and other equipment is being installed at the old Nelson copper properties on Jackson creek in the Jackson mountains. H. D. Bemis is superintendent. Bids are wanted for hauling 500 tons or more ore to the railroad. The distance is about 38 miles, two miles down a good canyon road from the mine to the desert, and then about 36 miles of good desert road to the station of Sulphur on the Western Pacific line.——DeVoe and Curry have just dispatched some 25% copper ore, and several other shipments have recently been made from the old camp of Red Butte.——Lessees are preparing to extract ore from the old Champion copper claims belonging to W. E. Christiernsson.

'On the Copper' via Sulphur, August 28.

The Friedman adit at Rochester is in over 650 ft., the present advance with three shifts being 18 ft. per day. The country is rhyolite that breaks well.——At the Foreman lease 300-

ft. level they are driving north from the transportation adit. This lease made a shipment of 40 tons, stated to be the richest average lot extracted from Rochester hill for a similar tonnage, being about $60 per ton. This syndicate will declare a $1500 dividend. It has only been operating since about the first of August.——The president of the Nevada Short Line railroad, A. A. Codd, announces that the track is now laid to the foot of the Rochester Mines tramway and the portal of the Friedman adit, and that he should be able to contract for hauling ore next week. The new Shea engine has been repaired. He has ordered another 30-ton Shea for immediate delivery. Several air-brake ore-cars of 25-ton capacity are to hand. Although present requirements call for about 125 tons of ore to the mill each day, the road will be able to transport 500 tons.

LINCOLN COUNTY

A 50-ton plant to use water concentration and flotation has been definitely decided for the Amalgamated Pioche company. The General Engineering Co. of Salt Lake City tests showed that two products could be made, namely, a 40% zinc concentrate with some gold and silver, and an iron concentrate high in gold and silver but low in zinc. A contract for the sale of this material has been made with the U. S. Zinc Co., a subsidiary of the A. S. & R. Co. Development at 1400 ft. in the mine is very satisfactory. About 12,000 tons of milling ore is on the surface, and over 20,000 tons is opened underground.

LYON COUNTY

Six sets of lessees are busy at the Empire-Nevada Copper Co.'s property, two miles from Yerington. Good ore is being extracted.——On August 26 the nitric acid plant at the Nevada-Douglas mill started work. Ore was crushed on the 30th, and the digesters are ready to commence.

NYE COUNTY

Tonopah activities during the past-week were as follows: Five mines and lessees produced 10,098 tons of ore valued at $207,724.——On October 1 the Belmont will pay its quarterly dividend of 12½%. The rhyolite vein at 1100 ft. has improved in width and value.——At 700 ft. in the Jim Butler the south vein is opening well.——The Extension will pay a 7½% dividend on October 1, a total of $95,430. July profits were $34,847. The 1350-ft. level is opening better than at the 1260-ft. level.——In the Mizpah mine of the Tonopah company, a block of unknown ore has been found just below the 500-ft. level.——At the Montana there are 45 men working on leases.——Exploration continues at the Mizpah Extension, North Star, Halifax, Rescue-Eula, Bonanza, Umatilla (diamond-drill at 1500 ft.), Monarch Pittsburgh, Cash Boy (6 in. of $26 ore cut at 1450 ft.), Gipsy Queen, and Buckeye-Belmont.

At the Round Mountain placer claims the first clean-up yielded about $15,000. This is only from 40 to 80% of the gold in the sluice-boxes. Profits are large.

STOREY COUNTY

At 2500 ft. in the Union mine quartz has been cut for 17 ft. width, 6 ft. of which assays $40 per ton, the remainder being of fair value.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—Mining at Magdalena shows considerable activity. The older mines are being operated full time.——A test shipment of ore was recently sent to the El Paso smelter by the Hop Canyon Mining & Smelting Co. Returns show 12.9 oz. silver and 7.02% copper. This company is completing a 1500-ft. adit, and expects to soon make large and regular shipments.——The Wheel of Fortune, adjoining the above on the south, has lately developed a five-foot vein of high-grade copper ore.——The Black Cloud mine, recently purchased by Wolf & Moore, is now shipping 120 tons of zinc sulphide per week. New hoist and machinery is being installed there.——The Calumet-New Mexico Mining Co. and others are hurrying development with a view to early shipments of copper-silver ores.

Magdalena, August 23.

The construction of a highway between the Clifton-Morenci district of Arizona and the Mogollan district of New Mexico has often been advocated. The manager of the Mogollan Mines Co., S. J. Kidder, states that the company pays about $47,000 per year for haulage of supplies. Other companies also spend large sums. The present route is unsuitable. The companies are agreeable to discuss the matter with the Greenlee County Chamber of Commerce.

TEXAS

ARCHER AND YOUNG COUNTIES

(Special Correspondence.)—Experiments that T. S. Lessohn has been making to separate nodules of copper from the extensive claybeds in these counties are reported to be very satisfactory. The copper-bearing material is dried, the clay passing off as dust. It has long been known that the copper deposits of this region were rich, but the difficulty that prevented its earlier development was that of extracting the copper nodules from the clay. The late General McClelland headed an expedition in the early seventies that had for its purpose the opening of these copper deposits on a large scale. Over $500,000 was spent by him on that one investigation. He shipped considerable quantities of the material to Philadelphia, but it was found that the cost of mining was too great to be profitable.

Alpine, August 17.

BREWSTER COUNTY

(Special Correspondence.)—It is reported that the Chisos Mining Co., which has been profitably operating a quicksilver property in the Terlingua district for several years, about 90 miles south of Alpine, will install a new 40-ton furnace. The district output of mercury should be a considerable increase over that of last year. Several people recently visited the district and are said to have obtained options upon the more promising properties. Mexican prospectors recently reported the discovery of cinnabar outcrops in the rough country on the opposite side of the Rio Grande from Terlingua, but it is not expected any effort will be made to develop the deposits in Mexico until that country is settled.

Alpine, August 17.

CULBERSON COUNTY

(Special Correspondence.)—An option has been obtained on part of a large sulphur deposit by T. L. Todd of Houston and associates. If the pending transaction is completed they will install machinery and develop the property on an extensive scale. There is a large quantity of sulphur on the surface. The fact that the deposit is remote from railroad transportation has heretofore prevented its exploitation. It is claimed that the mineral is of high grade and can be mined at low cost.

Houston, August 17.

HAYS COUNTY

(Special Correspondence.)—While prospecting for gold and silver in the hills near the head of the San Marcos river, a few miles from San Marcos, C. D. Griffin discovered a large outcrop of lead-zinc ore. Assays are satisfactory. Preparations are being made for development of the property. The discovery is in the central part of the State, more than 100 miles from the Llano district, where the nearest precious minerals are found.

San Marcos, August 17.

UTAH

In the second annual mine-rescue and first-aid contest at Castlegate, Carbon county, on August 21, the Sunnyside team defeated five other teams with 97.5%. These men will go to the national contest at San Francisco. The meet was held under the auspices of the Utah Fuel Company.

Juab County

On August 26 the hoisting-plant at the Victor Consolidated was destroyed by fire. The blaze started at 300 ft. depth and burned the shaft-timber to the surface. Lessees were working at this level.——At 1780 ft. in the Eagle & Blue Bell, ore is showing for the full width of the drift.——The new plant of the Utah Minerals Concentrating Co. treated about 1000 tons of ore in 30 days. Part of this is from the Chief Consolidated. Concentrate assays 51% lead and 13 oz. silver per ton. The mill was erected to treat the low-grade ores of the district.

Salt Lake County

A 200-ton mill to treat ores from the Cardiff and other mines in the Alta-Big Cottonwood area is probale, according to Ezra Thompson of the Cardiff company.

During the quarter ended June 30 the Utah-Apex company made a net profit of $72,154. Gross receipts totaled $233,821. The Parvenu shaft was sunk to 1300 ft., and the cross-cut at that depth should soon cut the vein. A considerable amount of development was done. A flotation process is being installed at the mill. On October 1 a dividend of 12½c. per share will be paid.

Summit County

At the Broadwater Mills 500-ton plant at Park City 100 men are busy on construction. Treatment should commence in about two weeks.

Summit County

A contract has been let by the Daly-Judge company to the Allis-Chalmers company for a hoist of 2700-ft. capacity. The average speed will be 1200 ft. per minute, the machine to be driven by a 400-hp. motor with 1000-hp. starting duty. A new steel head-frame and other equipment is being installed. The manager of the Daly-Judge, J. W. Lambourne, has let a contract for 2000 ft. of additional work in the Snake Creek tunnel.

In *Economic Geology* for April-May the Tintic district is discussed by Waldemar Lindgren. An abstract will appear later.

WASHINGTON

Spokane County

The Spokane Chamber of Commerce is collecting statistical data for a new handbook on mining in the Northwest. County officials in the states and recorders of the provinces of Canada have been asked to supply lists of the live mining properties in their territories. Considerable data have already been received. Information is being secured from the states of Montana, Idaho, Oregon, and Washington, and from British Columbia and Vancouver Island. The information will be compiled by the statistical department and issued under the title of the 'Northwest Mining Handbook.'

Stevens County

The Northport smelter is being re-modeled. Furnaces No. 1, 2, 3, and 4 are to be dismantled, and No. 5 and 6 are to be used for the treatment of copper ore. Lead furnaces are to be installed.

Improvements and additions to the mill at the United Copper mine near Chewelah, Wash., have been completed, and the entire plant now in operation, according to Conrad Wolffe of Spokane, president and general manager. Flotation is employed. Seventy men are working.

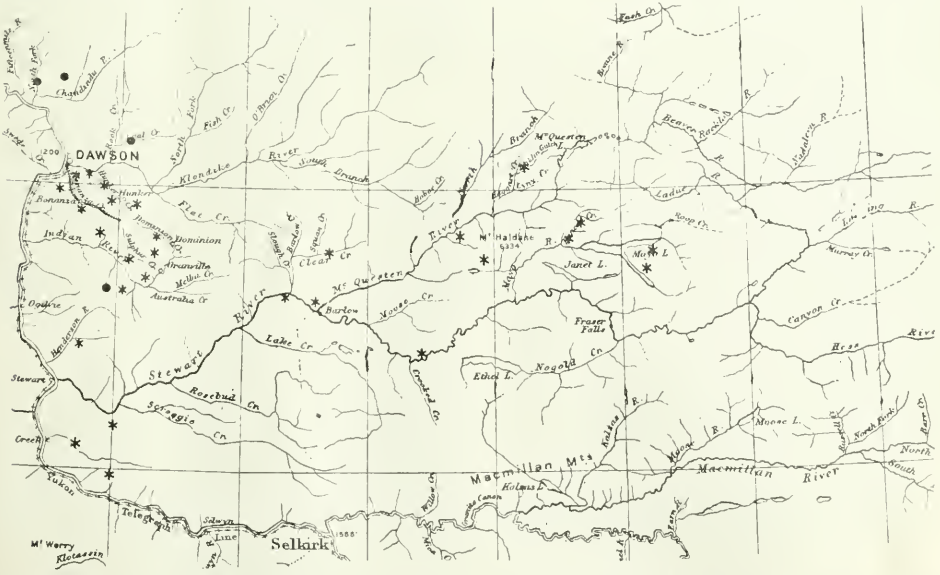
CANADA

Yukon

A geological examination is being made of the Mayo district by D. D. Cairnes and W. Cockfield. The silver-lead mines on Galena creek will be included in the reconnaisance work, a detailed investigation to be made next season.

British Columbia

The Rocher de Boule Copper Mining Co. in July shipped 3000 tons of ore assaying 9% copper and $2.50 gold and silver to the Granby smelter at Grand Forks. The mine is near Hazleton. The ore was extracted from above 350 ft. Deeper development is opening ore of equal value. The profit in July was $50,000. J. F. Cowan of Salt Lake City is president of the company.



PART OF THE YUKON TERRITORY SHOWING THE MAYO DISTRICT. THE M'WHORTER LEAD MINE IS ON GALENA CREEK, A TRIBUTARY OF THE NORTH FORK OF THE M'QUESTEN RIVER. THIS PART OF THE COUNTRY IS THE HEADWATERS OF THE RIVER. ORE IS HAULED 30 MILES TO MAYO LANDING, THEN DOWN THE STEWART RIVER, UP THE WHITE PASS RAILWAY TO SKAGWAY, AND THEN DOWN THE PACIFIC COAST TO SMELTERS. THE STARS REPRESENT GOLD DEPOSITS.

Dividends paid by companies in this province in 1915 are as follows:

Mine.	August.	8 months.
Granby	$225,000	$225,000
Canadian Consolidated	116,088	232,176
Hedley	.....	120,000
Le Roi No. 2	.....	28,800
Total	$341,088	$605,976

On September 10 the Standard Silver-Lead company will pay 2½c. per share, equal to $50,000. Equal monthly dividends are expected from now on. The total is $1,600,000. Lead concentrate goes to the Trail smelter, the settlement being 5c. per lb. for lead, and a charge of $8 per ton for freight and treatment. Zinc concentrate is being stored. About 100 men are employed. The flotation plant is working well.

The Slocan Star, near Sandon, is treating about 120 tons of ore per day of 22 hours. This yields 300 to 350 tons of zinc-silver and 125 to 150 tons of lead-silver concentrates. Sixty men are employed. On No. 4 level 45% zinc ore has been opened. The mine has about 6000 ft. of workings.

KOREA

On July 31 the Oriental Consolidated distributed 50c. per share. This is No. 30.

On account of floods the July output of the Oriental Consolidated was only $97,500.

MEXICO

Hidalgo

The Santa Gertrudis Co. reports that in June the mill treated 14,066 tons of ore yielding a profit estimated at $23,000.

Jalisco

According to Makeever Bros., of New York, the last letters from their El Favor property were on June 6. It was then stated that cyanide precipitate worth $13,000 was stolen, and Stephen Parmenter, of Los Angeles, was killed by bandits who attacked the bullion train. This was guarded by soldiers who disappeared when the attack was made.

Sonora

General P. Elias Calles, Carranza commander of Sonora, has closed all saloons in Nacozari and Cananea. August payrolls at the Moctezuma and Tigre mines and mills will be on a silver basis. Out of about 16,000 tons of concentrate stored at the Moctezuma mill about half has been sent to Douglas. All concentrate has been shipped from the Moctezuma mill to Douglas, a total of 444 cars.

According to the *Douglas Daily Despatch* of August 30, Governor Maytorena, the Villa chief, will relinquish the office of governor of Sonora on September 15, as announced from his office. Albert Morales, now state councillor in Maytorena's cabinet, will become governor. General Felipe Angeles, who is reported to be on his way from Chihuahua with 3500 men, will assume the military chieftainship on behalf of the Villa states of Sonora and Sinaloa. The report that Villa had been assassinated was denied by Maytorena, who received a telegram from Villa. The advent of Angeles into Sonora is being watched with great interest as to the possibilities of his making a strong showing in the State. Confirming the reports of the coming of the former Madero-Carranza-Villa leader into Sonora, Maytorena officials are still reticent as to the extent of the movement and what it will mean to the State. Carranza officials have reports that Angeles is coming to Sonora for the purpose of disavowing Villa, and in all probabilities attempting to turn the State into a new political unit, not embracing the Carranza or Villa cause, but rather the element who are now exiles, composed of old federals.

Final figures of the gold and silver output of the United States in 1914 will be published in full next week. The gold yield was 4,572,976 oz., and silver, 72,455,100 oz., both increases.

PERSONAL

George Watkin Evans is in Alaska.

Charles W. Morse is here from Butte.

Jas. W. Abbott, of Los Angeles, was here this week.

Horace V. Winchell was at Grass Valley during the week.

A. J. McNab of Thompson, Nevada, is visiting the Exposition.

F. Lynwood Garrison is expected here from Tuscon next week.

D. B. Donovan has gone from Johannesburg to Tarkwa. West Africa.

P. D. Burtt is at the Nevada Packard mine, near Rochester, Nevada.

W. Ingham has been elected president of the South African Institution of Engineers.

J. W. Hutchinson and A. H. Howe of the Goldfield Consolidated are at the Palace Hotel.

L. C. Graton is in Shasta county, engaged in geological work for the U. S. Geological Survey.

R. T. Walker has been appointed superintendent of the Techatticup mine, at Nelson, Nevada.

J. M. Callow of Salt Lake City passed through San Francisco on a motor tour through California.

John W. Finch and W. H. Wiley have been in San Francisco in connection with mining litigation.

G. M. Butler has been appointed Dean of the College of Mines and Engineering in the University of Arizona, at Tucson.

F. L. Sizer will be in San Francisco for the engineering conventions, having been appointed a delegate by the Governor of Arizona.

E. V. Bray, mill-superintendent of the Exploratie en Exploitatie Maatschappiji Bolang Mongondon, Goervepalej, North Celebes, Dutch East Indies, arrived here on the *Mongolia*. He returns on the *Shinyo Maru* on November 20. The company is operating an all-sliming plant. During 1916 the company expects to begin construction of a new mill on the Minto concession, 10 miles distant from its older property.

Schools and Societies

The University of California reports that there are 1517 freshmen attending this fall, larger than in 1914. For engineering there are 160 against 184. The present national unwillingness to engage in new engineering construction is thought by the University to be the explanation. Of the 160 engineering students in this year's freshman class, 95 are in mechanics and electrical engineering, 46 in civil engineering, and 19 in mining. The total registration of all students is 5407, which is nearly 300 more than this time last year, and the year's registration in all departments, including the summer session, will exceed 11,000.

The American Mine Safety Association of Pittsburgh, Pennsylvania, states that the impression seems to have been conveyed by articles appearing in some technical journals that the Association has ceased to exist. According to the president, A. F. Knoefel, and the secretary, H. M. Wilson, this is not so; on the contrary, it is not only very much alive but will be more active than in the past, though under another name. The recent ballot concerning the amalgamation with the National Safety Council was almost unanimously in favor of such action, and the executive committee of the latter also favors the taking over of the American Mine Safety Association as its Mining Branch. The effect will be to practically centralize all safety movements within the National Safety Council. The American Mine Safety Association will hold its annual meeting as contemplated at Birmingham, Alabama, on September 3.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, September 2.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	5.15— 6.10
Quicksilver (per flask)	$95
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, September 2.—The copper market is easier, with buyers reserved; lead is quiet, and not quite so firm; the zinc market is uncertain.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Aug. 26	17.87	July 21	19.04
" 27	17.87	" 28	18.62
" 28	17.87	Aug. 4	18.27
" 29 Sunday		" 11	17.94
" 30	17.87	" 18	16.89
" 31	17.75	" 25	16.27
Sept. 1	17.75	Sept. 1	17.83

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended August 14 totaled 13,927,812 lb., valued at $2,586,788. Russia in Europe absorbed 3,697,945; France, 3,199,047; England, 2,574,752; Russia in Asia, 1,792,392; Italy, 1,390,429; and Denmark, 1,008,524 lb. Imports of all kinds of copper metal totaled 7,246,671 lb., worth $1,021,507. Of this, 2,271,861 came from Peru, 1,102,000 from Brazil, 1,413,365 from Cuba, and 1,988,999 lb. from Canada.

Exports during the fiscal year ended June 30, 1915, totaled 677,303,822 lb., valued at $96,238,800, against 974,791,676 lb. worth $144,895,519 in the previous period. Germany showed a decrease of 281,000,000 lb., and England and Italy increases of 88,000,000 and 55,000,000 lb. respectively.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug. 26	46.75	July 21	47.47
" 27	47.12	" 28	47.29
" 28	46.87	Aug. 4	47.08
" 29 Sunday		" 11	47.27
" 30	47.00	" 18	47.33
" 31	46.62	" 25	47.08
Sept. 1	46.25	Sept. 1	46.77

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The financial situation in England, the low rate of exchange, probably accounts for the record low price of silver. On August 25 about 160,000 oz. was sent from San Francisco to China. London stocks are estimated to exceed 19,000,000 oz. Exports from London to the Orient to August 11 total £4,496,500, against £3,031,250 in that period of 1914.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug. 4	95.00	Aug. 18	90.00
" 11	95.00	" 25	95.00
		Sept. 1	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

Final figures of the quicksilver production of the United States in 1914 show a total of 16,548 flasks, valued at $811,680, according to the Geological Survey. This is a decrease of 3665 flasks. California yielded 11,303; Nevada, 2089; and Arizona and Texas, 3156 flasks, the last three States showing increases.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Aug. 26	4.70	July 21	5.58
" 27	4.90	" 28	5.50
" 28	4.90	Aug. 4	5.12
" 29 Sunday		" 11	4.79
" 30	4.90	" 18	4.44
" 31	4.90	" 25	4.49
Sept. 1	4.90	Sept. 1	4.87

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Aug. 26	14.50	July 21	20.33
" 27	16.00	" 28	18.96
" 28	16.00	Aug. 4	17.79
" 29 Sunday		" 11	15.12
" 30	16.50	" 18	12.21
" 31	16.25	" 25	11.96
Sept. 1	15.25	Sept. 1	15.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.73	14.17
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The rise in spelter had its effect on prices of ore in the Missouri-Kansas-Oklahoma region last week. The average was $18.50 higher. The output was as follows: blende, 4678; calamine, 308; and lead, 967 tons, averaging $72.68, $47.20, and $43.84 per ton respectively. The total value was $396,861; 35 weeks, $15,249,010.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	32.51	....
June	30.72	40.26	Dec.	33.60	....

ALUMINUM

A steady demand, a good part of which has been for export, is responsible for aluminum being quoted at 34 to 35c. It would require but little pressure to send the market to higher levels.

ANTIMONY

There has been some good inquiry with considerable resultant business in antimony, but comparative offerings have brought the quotation for Chinese metal down to 28c., duty paid.

Eastern Metal Market

New York, August 27.

The long expected turn in copper, lead, and zinc came along two days ago, but how substantial it will prove to be remains to be seen. The facts at present are that copper has advanced from 16 to 18c. per pound, lead has gone up $8 per ton, and zinc has increased nearly 4c. per pound. All this took place between August 24 and 27. Of course, the cry of manipulation has been raised, but it cannot be disputed that large quantities of all three metals have changed hands, with buying on both foreign and domestic account. On August 24 all the indications were for a runaway market in lead, while copper was nearly as excited. The rise in zinc was more rational in that it started earlier. Tin has advanced 1c. per pound, more because of strength in London rather than by reason of buying here. Under pressure to sell, Chinese antimony has declined and is now quoted at 28c., duty paid. Aluminum is strong and quotations have been well sustained.

The exchange rate for the English pound sterling was down to $4.63\frac{3}{4}$ on August 26.

Quotations for semi-finished and finished steel products have continued to advance. For plates, shapes, and bars the general quotation is now 1.35c., Pittsburg. Billets are exceedingly scarce, and prices have soared to such an extent that manufacturers see a better profit in selling unfinished steel than in rolling certain products. Shrapnel and high-explosive shell-rounds are selling at around 3c. per pound, or about twice what can be obtained for ordinary products. A result of the high prices obtainable for steel has caused steel-making iron to be sharply advanced; while foundry irons are advancing also; in fact, too rapidly in the judgment of many, inasmuch as the foundries in some parts of the country are not yet busy. Exports of steel are heavy. The demand for shell and rifle-making machinery shows no abatement.

COPPER

After 10 weeks of dullness, accompanied by declining quotations, the market took a sudden and, in some respects, unprecedented, turn on August 24. Up to noon on that day electrolytic could be procured easily at 16c. cash, New York. Late in the day 17c. was asked, and the following day second-hands were asking 17.50c., while producers were asking 18c. With the change the market became excited. There was some large buying, credited to a desire on the part of ammunition makers to provide for their future needs. There could have been still more business had not sellers shown a disposition to withhold from selling, a move which not only restricted business, but added greatly to the uneasiness of consumers. Inquiries poured into the market. Prior to the change which came over the situation there was some forecast of what was coming, in the desire of second-hands to buy, provided they could get the metal at a shade under 16c. Needless to say, they do not buy unless their judgment tells them the time is ripe to buy for a future profit. It yet remains to be seen how far upward the present trend will carry the market; something which is extremely uncertain in view of the conflicting rumors which are afloat. It is alleged on one side that the market has been manipulated to bring about an abrupt advance, and on the other that it had been unduly depressed by foreign influences traceable to Great Britain's desire to buy cheap copper. For weeks prior to the jump in prices it had been reported almost daily that large export buying was imminent, but the trade had been so regularly disappointed that it began to view the reports lightly. On August 25, the day following the sudden hardening of the market, the London price of electrolytic advanced £1, and the following day £4 10s. more. At the same time, despite the London movement, the price there was still £4 below New York parity. On August 27, second-hands were quoting (New York) 17.50 to 17.75c., and producers 18 to 18.50c. On the strength of the higher quotations copper wire was advanced 1c. per pound to 18.50c. base. With all the activity, the fact remains that commonplace consumption of copper is not yet normal, while it also is true that the exports of ingot copper have been light. Up to August 28, exports totaled only 14,215 tons. The consumption for war purposes is heavy enough to fill some departments of the mills to capacity, but the trade insists that this demand is not sufficient to offset the falling off in other directions. Lake copper, up to the turn, declined with electrolytic, choice brands having been sold at 19c., and less favored brands at less. The premium for Lake has practically disappeared at the present time.

ZINC

About August 20 a demand appeared for spelter. It was not spasmodic, but steadily increased in volume, until by August 25 the market was not only active, but excited, a condition which sellers helped along by appearing not overwilling to sell. The quotation on the 20th was 11.25c., New York, but by the 26th it had reached 14.75c., and was firm at that figure, although the buying showed signs of tapering off. On the 27th the New York price for prompt went to 16c. Consumers have become more wary. Up to the beginning of the advance brass-mill special has been held at 15c., and choice brands at 35 to 40c., although little business was done at the latter high prices. Producers of the A-1 grades were sold up, and simply had no reason to quote less than they did at the end of the big advance of a few weeks ago. When the market became active last week, European as well as home consumers came into it strong. An indication of the uncertainty of the market lies in the fact that on August 23, sheet zinc was reduced 2c. per pound to 15c., f.o.b. mill, whereas on the 24th it was advanced to 16c. Exports of spelter from August 1 to 28 totaled 3589 tons.

LEAD

Late on Tuesday, August 24, buyers came tumbling into the market, and for a time it looked as if the wild days of early June, when the New York quotation went to 7c. and over, were to be repeated. There was every indication of a runaway market. Sellers went home that night with orders for thousands of tons left unfilled. Next day the A. S. & R. Co. advanced its New York quotation 10 points to 4.60c., in which it was followed by independent sellers. The scramble to buy was not checked to any great extent, however, and the following day the leading interest raised its quotation another $2 per ton, or to 4.70c. On the 27th this concern advanced its price again, from 4.70 to 4.90c., or $4 per ton. Dealers showed their confidence in the market by seeking to buy on the rise at 2 to 5 points over the prevailing price. The fact that many were burned in the previous frantic flurry of buying seemed to have been entirely forgotten. The exports, August 1 to 28, totaled 1958 tons.

TIN

Except for one or two periods when there was a fair activity on the part of small consumers of tin whose buying was largely confined to lots of 5 to 15 tons, there has not been much doing. In London there has been a marked improvement in the metal, and this has been reflected here; that is, so far as prices are concerned. On August 24 the New York quotation was 33.75c. for spot metal, whereas on the 26th it was 34.75c.

BOOK REVIEWS

Petroleum Technologists' Pocket-Book. By Sir Boverton Redwood and Arthur W. Eastlake. P. 454. Ill., index, also colored plate and 8 maps. Charles Griffin & Co., London, and J. B. Lippincott Co., Philadelphia, 1915. For sale by the Mining and Scientific Press. Price, $3.

In spite of the War, petroleum production of the world in 1914 showed an increase of approximately 15,000,000 bbl., the total being 400,483,489 bbl. Of this the United States yielded 66.36%, and accounted for most of the gain. Russia and Mexico produced 16.74% and 5.29% respectively. The oil business has suffered from over-production and lack of business, while enormous stocks are on hand. Yet the search for oil-bearing areas continues. The little maps accompanying this pocket-book show where every known deposit in the world is situated. Part I of the work briefly describes the deposits so marked, prospecting for oil, and acquisition of oil lands. Some geological notes are given in the next section, including monoclines, anticlines, and synclines, all important to the oil geologist and driller. The physics and chemistry of oil covers 106 pages, including the yield of products of crude oils throughout the world. The chapters on production (drilling methods); refining, transport, storage, and testing; and uses of petroleum and its products is discussed concisely and in an interesting manner. A useful lot of statistics and miscellaneous data completes a handy little book which all petroleum engineers should have with them in the field and office.

Twenty-Fifth Annual Report of the Transvaal Chamber of Mines, for the Year 1914. P. 472. Index, and large map of the Rand. Argus Printing and Publishing Co., Ltd., Johannesburg, 1915.

Importance of the Transvaal as a gold-producing country is well shown at the Panama-Pacific Exposition by large spheres and an obelisk, by which its proportion (38.3%) of the world's yield is noted. The contents of the annual report of the Chamber of Mines also show the extent of the industry. Seventy-four large companies comprise membership of the Chamber, and during the year the various committees dealt with native labor, recruiting, and grievances, health conditions at the mines, mining education, work of the central buying committee, disposal of gold, legislation including miners' phthisis, workmen's compensation, taxation, patents, water supply, and many other matters of importance. The Witwatersrand Native Labor Association's report covers 45 pages. There were 213,829 natives recruited at a cost of £134,466. The revenue from fees on natives distributed was £259,158. The profit (a refund) was £90,719. At the end of 1914 there were 176,105 natives and 21,875 whites employed at the gold mines. In 1914 there was an average of 6247 machine-drills operated. An average of 9.68% of waste was sorted from the material mined. The 9757 stamps and 294 tube-mills crushed 26,369,946 tons of ore yielding $6.28 per ton. Total costs were $4.10 per ton. Dividends paid by gold companies totaled £8,073,436. Coal output was 5,157,268 tons valued at £1,150,746; diamonds, 1,142,683 carats at $4.90 per carat; silver, 890,562 oz.; copper ore, 15,257 tons worth £330,381; and tin ore, 3387 tons worth £310,222. During the fiscal year ended March 31, 1914, all mines paid taxes totaling £2,550,147. The report contains an amazing collection of statistics of great interest.

Combustion and Smokeless Furnaces. By Jos. W. Hays. Second edition, revised. P. 118. Ill., index. Jos. W. Hays, Rogers Park, Chicago, 1915. For sale by the Mining and Scientific Press. Price, $2.

Engineers and metallurgists are fully aware of the necessity of good combustion of fuels and prevention of fume from furnace stacks. Considerable litigation has resulted from the latter trouble. Recent investigations into the soot nuisance at Pittsburgh are fresh in the minds of engineers. Enormous damage, aggregating millions of dollars annually, is caused by smoke from chimneys in cities. The burning of fuels under boilers is generally inefficient, hence smoke troubles. Hundreds of devices have been patented to try and improve combustion and reduce smoke, but few of them are worth testing. Proper design of boiler burnaces is not always considered, although of great importance. In the work under review the author starts at the bottom with a definition of heat and combustion, which is understood by few men actually operating a furnace. Combustion and the boiler-furnace is next considered, including details of fuels, heat, and losses. Air and temperature are both necessary to the complete combustion of the gases arising from soft coal. If either is lacking, there will be smoke. The author considers that the 'chimney evil' must be considered from the standpoint of health and damage to property. Chicago uses over $30,000,000 of coal per year, and the general waste due to incomplete combustion is very large. Smokeless furnaces are classified under two main heads, (1) mechanically-fired furnaces, and (2) hand-fired furnaces, with several modifications, which are all well discussed. In concluding, the author states that perfect combustion cannot be attained, but good results can be obtained. The evaporation test as an evidence of furnace efficiency, he discredits, this not applying to evidence of boiler efficiency. An appendix to the volume describes a gas analyser, draft gauge, and other instruments designed by the author.

Catalogue of Technical Periodicals. Compiled by Alice Jane Gates, assistant librarian of the Engineering Societies, with co-operation of a committee of the New York Library Club. P. 110, 8 by 10 in., cloth. Library Board of the United Engineering Societies, New York, Price, $3.

This volume, number one of the bibliographical contributions of the library of the Engineering Societies, is a worthy beginning of a promising series. It is a valuable catalogue, or rather a directory, of the technical periodicals and engineering society transactions in or near the city of New York. It is as valuable to an individual as it is to libraries, in that an engineer, by referring to it, may readily locate a periodical reference in his research notes. The seven large and representative libraries contained in the catalogue are as follows: Columbia University, Chemists' Club, American Society of Civil Engineers, Engineering Societies, New York Public, Plainfield Public, and Stevens Institute of Technology. The catalogue is a great step in a nation-wide plan to effectively record the periodicals throughout the various cities, and is the outgrowth of a suggestion made by the late Dr. John Shaw Billings to W. P. Cutter, the librarian. The attempt was made to have a complete record of foreign and domestic periodicals, that is, to include all changes of title, consolidations, record of indexes published, and suspension or cessation of publication. In short, it aims to be a concise history of every important technical periodical in the seven libraries above mentioned. The entries in the pages are compiled in an original and pleasing manner. The names of the periodicals, arranged alphabetically, are followed by a complete statement of the numbers published. Below this are given the numbers of the periodical to be found in one or more of the libraries represented. The size of the page is 8 by 10 in. and the printing is set up in two columns making it easy to follow. There are, in all, over 2600 main entries and cross-references with a list of indexes consulted, a list of the libraries and information regarding them, and a brief statement of the system followed. Finally, it is printed on heavy glare-proof paper, is strongly bound, and will prove a valuable addition to any engineer's library.

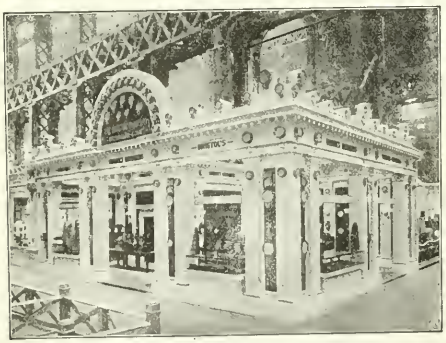
New Machines and Devices

Information based on letters and catalogues from manufacturers.

Recording Instruments at the Exposition

The Bristol Company of Waterbury, Connecticut, manufacturers of Bristol's recording instruments, indicating instruments, metal-belt fasteners, and safety set and cap-screws, has an area of 32 by 42 ft. in the Palace of Machinery at the corner of Avenue D and 2nd street.

There are two wide doorways, one on each street, and the doorway on 2nd street is surmounted by a large arch. This arch is decorated by 48 recorders, 24 on each side. There are over 150 additional recorders which decorate the ornamental cornices and the interior of the booth. These recorders are made to fit in the general style of ornamentation of the booth, and they not only serve as an architectural embellishment, but also typify the products of manufacture of the company, since they are of various sizes, shapes, and forms, from the large original 12-in. chart-recorder to the small round 6-in. chart-recorder. All of these are the same as the actual instruments, as to external appearance, the clocks and internal mechanism only having been omitted. There are over 125 recording instruments exhibited, comprising the complete line of instruments for pressure and vacuum, liquid levels, differential pressures, temperature, electricity, time, motion, speed, humidity, flow, barometric pressure, and miscellaneous measuring instruments.



EXTERIOR VIEW OF BRISTOL EXHIBIT BOOTH.

There are also shown four different styles of metal-belt fasteners, comprising the patent steel belt-lacing, patent belt-plates and split rivets, wire lacing, and oval-pointed belt-hooks.

Bristol's patent safety set and cap-screws are shown in 14 complete sizes.

The complete exhibit is carefully placarded, indicating the particular applications of the various recorders. A large part of the exhibit is well arranged on tables, so that actual demonstration and tests might be easily and readily made by any visitor. Two of these demonstrating outfits show the operating principle for the transmission and recording of temperatures and pressures up to 30 or 40 miles. There are over two dozen recorders operating continuously, showing air temperatures, voltage, frequency, barometric pressure, water pressure, gas pressure, liquid level, speed, humidity, etc. There is also an instrument indicating and recording the tide variations in San Francisco bay, operated on the electric long-distance principle.

The Bristol Company has been awarded the Grand Prize, which is the highest possible attainable, by the International Jury of Awards.

Commercial Paragraphs

The Pacific Foundry Co., of San Francisco, reports that it has secured an order for six new Herreshoff furnaces, temperature control, to be erected at the Tacoma smelter in connection with the extensions to treat additional copper ore. This order was received after having supplied four furnaces to the Garfield smelter, Utah, where they did good work.

On August 14 the Dodge Manufacturing Co., of Mishawaka, Indiana, held its ninth annual outing at Michigan City in that State. Over 3000 people, including officials of the company, employees, and friends, attended. This affair was in keeping with the company's welfare work. The company claims that it is the largest producer of power-transmission machinery in the world.

The Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, Missouri, has issued Form No. 2004, describing the Appleton, Wisconsin, water-works. The plant consists of a filtration installation and pumps. Power is suplied by two 225-hp. 3-cylinder, 4-stroke cycle Diesel oil engines made by this firm. They have been operating with excellent results for over a year, driving four 2,000,000-gal. per day double-acting triplex pumps, one at each end of each engine shaft, also two 15-kw. link-belt driven generators. Costs were reduced over 50%, on a basis of 1000 gallons pumped.

Bulltin 72 (23 pages) of the Sullivan Machinery Co., Chicago, describes the Sullivan drill-sharpener, which was illustrated and briefly covered in the Press of May 29. The machine is worked by compressed air, and is used for forging and sharpening rock-drill and hammer-drill bits and forming shanks, by hammering. The net weight is 4000 lb. Advantages claimed are as follows: quality of steel preserved, gradual work, high capacity (a new bit from bar-stock, one heat, in one minute or less), temperature, compactness, convenience, strength, variety of work, safety for operator, automatic lubrication, high-class material and workmanship, air economy, and absence of cross-strains in the machine.

The Braun laboratory appliances, consisting of crushers, pulverizers, samplers, furnaces, burners, and other equipment which is used in all parts of the mining and industrial world, have been awarded a gold medal at the Panama-Pacific Exposition. The exhibit was in conjunction with the U. S. Bureau of Mines which has maintained a working laboratory for research work that has proved extremely valuable and interesting to visitors to the Exposition. In addition to this prize The Braun Corporation of Los Angeles, and the Braun-Knecht-Heimann Co. of San Francisco, have been awarded silver medals as collaborators. The above awards are not the first ones received by the Braun appliances, gold medals having been awarded at the Expositions at St. Louis, Jamestown, Portland, and Bendigo, Australia. Braun labor-saving devices are used in the remotest parts of the world, their merits being well known.

EDITORIAL

T. A. RICKARD - Editor

POPULATION of the United States, it is estimated, has recently passed the hundred-million mark. Since 1879 the increase has been 52,494,000 or over 100% in 36 years.

ON August 14 the first year of commercial operations at the Panama Canal was completed. During the 12 months 6,494,673 tons passed through, paying toll to the amount of $5,216,149. Receipts are increasing steadily.

GALVANIZERS are buying spelter again. For their sake and that of important allied industries, we hope that the spelter market will behave itself, remaining steadily at a good, but not prohibitive, quotation, such as 10 cents per pound.

NECESSITY is the mother of invention. The exigencies of the time are stimulating the finding of substitutes for numerous substances heretofore made in regions now inaccessible to ordinary trade. Many monopolies will be shattered by the War.

PLATINUM is being exported from Colombia at an accelerating rate. In 1907 the total production was only 245 ounces; for 1914 the export returns show 9382 ounces. Most of this metal came from the Condoto river district, where the Consolidated Gold Fields of South Africa is operating.

DENVER is to figure in the munition business, it is announced. The General Ordnance Company has been organized by six manufacturing concerns, which have already secured several contracts with European governments. Colorado is making a handsome output of zinc and other metals required for making munitions.

THIS YEAR the strain felt in the autumn by reason of the financing of our harvest will not be undergone, because gold is plentiful. Crops are splendid, in quantity and in condition. Export of food-stuffs is unprecedented. The manufacture and sale of munitions is making a generous market for the base metals. No reason exists for anticipating any check in the industrial uplift.

WEALTH is being transferred from Europe to America in prodigious chunks. Mr. Charles M. Schwab, of the Bethlehem Steel Company, is reported to be in a fair way of making $75,000,000 in one year. That sum of money will be paid by European governments, and eventually by European people, to an individual in the United States. Other sums of money running into colossal figures will suffer similar migration across the Atlantic.

COPPER is said to be produced at the Kennecott mine, owning the Bonanza deposits on the Copper river, Alaska, for 5 cents per pound. The record of the previous decade was the 7 cent cost of the Wolverine in Michigan, but there the figure has risen to 8½ cents. The big disseminated copper deposits lowered the record, notably the Utah Copper; later the Chuquicamata (of the Chile Copper Company) took the palm for cheapness, at under 6 cents per pound.

ON consulting our staff, we find that the things most worth seeing at the Exposition are (1) exterior of the Fine Arts building, (2) model of Panama Canal, (3) the Model Mine, (4) the exhibit of the U. S. Geological Survey and of the Bureau of Mines, (5) the Canadian exhibit, (6) United States Steel Corporation's exhibit, (7) the French building, (8) school systems in Educational building, (9) assembling of the Ford automobile, (10) the Bay of San Francisco.

CO-OPERATIVE experiments in production in the United States have failed and are doomed to fail because they do not give free scope for individual ambition. The few misplaced drones who do the loafing and share equally in the profits drag down the better men to their own level. Another reason for the failure lies in the remoteness of the reward. A profit that may come in six months or a year has not enough attraction to overcome the desire of taking life easily in the present. A more formidable obstacle to co-operation arises when losses ensue; for while workmen are always willing to divide profits, they are usually opposed to any sharing of loss.

FOR the first time in the history of the country the the mining brokers of the United States are to meet in conclave to formulate a few simple rules for the protection of the mining industry and the investing public —so it is announced. And it is added that "by realizing these two purposes" the brokers expect to further their own interest. The idea is excellent. Stock-exchanges all over the country have arranged to send delegations to this brokers convention, which is to be in session in this city from September 21 to 25. The circular says that this meeting will be concurrent with that of "the American Mining Engineers," but the meeting of the Institute will be held during the week previous. However, the

Mining Congress will be in session at the dates mentioned. It would be well if a committee of brokers would appear before the Congress and explain its ideas for "eradicating those pests and hangers-on of legitimate mining enterprises which have in the past done much to discredit the mining industry" and for "eliminating the irresponsible and market-rigging elements in the brokerage business." A frank discussion might be useful; certainly it would be interesting.

THE mineral wealth of a country may be compared to a sum of money hidden in the ground. it does not renew itself and every dollar extracted leaves just so much less for future use. Yet it is a singular fact that among a people supposedly grounded in the rudiments of political economy, the progressive exhaustion of this precious resource is everywhere heralded as a triumph of enterprise and a gauge of national prosperity. The nation publishes periodically the record of the scattering of its assets never to be regained and waits with a smile of complacence for general congratulation. The moral, therefore, is to avoid waste in the exploitation of our mineral resources.

RECENTLY a San Francisco evening paper, which it would be unkind to name, published a financial article announcing that "California's predicted gold mining boom seems near." This prediction is based on the fact that a certain Mr. Leopold Hyde, a South African mining engineer. not known to us, had reported that "in mineral wealth California is a land of Aladdin. She leads the earth in the production of gold, quicksilver, and oil, and vast areas of unexplored mineral territory within her borders await the advent of the prospector and miner." Whereupon the financial expert of the *Evening Yawp* makes the observation: "It was with such a report before them that British capitalists, after the advent of the War, began to investigate the California goldfield." That seems unlikely. London capitalists are not quite educated to the appreciation of such rhetorical confectionery. Besides they have heard of California before. Moreover the production of gold in the Transvaal was $172,602,160 last year and that of California was $20,653,496, so that the aforesaid capitalists may find reason to doubt the other statements of the supposed South African mining engineer, who appears not to have heard of the Transvaal as a productive goldfield. In truth, the day has gone for such flapdoodle. It may be good enough for the financial columns of the *Evening Yawp*, but it does not further the welfare of the mining industry. California does not need such twaddle to win recognition in London or elsewhere.

Silver

While gold has appreciated and the base metals have exhibited extraordinary fluctuations in price, the quotation for silver has been steadily downward, until the low record of 46⅝ cents per ounce was reached on August 31. However, we do not doubt that the end of the War will synchronize with an improved market for silver, because that precious metal will be required in large quantity for subsidiary coinage. In Europe, as in Mexico, paper has displaced silver as a medium of common exchange. That condition will be reversed, to a large extent, when normal industry revives in the regions now subject to lawlessness, for to the peaceful dweller in Poland the Germans and the Russians are destroying industry even more effectually than the Carranzistas and the Zapatistas in Durango. Meanwhile our readers will find a good deal of timely information on the silver market on our metal page from week to week. There we give data concerning the London, Indian, and Chinese markets for silver. To realize the part that India plays it is only necessary to say that India absorbs 55% of the world's annual output of silver and produces only 2%, mostly as a by-product in the gold mining of the Kolar district. India's capacity for absorbing the precious metals is a fascinating subject. Estimates of the value of these hoardings runs into billions of dollars. The cause for it is similar to that at work now as between New York and London, namely, the balance of trade, which, for a long time, has been greatly in favor of India. The simple habits of the people, the character of the climate and the soil unite in reducing the necessities of life to a minimum; so that foreign purchases are small as against their exports. In eastern Bengal, for example, the annual sale of jute alone represents $2.50 per head of the population. This goes out mainly in exchange for gold and silver. Meanwhile the Mexican production during the last three years has not decreased as much as might be supposed; we have no reliable figures, but we hazard the guess that, until recently, Mexico has been contributing a large proportion of its normal production of 70 millions, out of the 225 million ounces produced by the whole world. The two factors that are depressing silver are the lessened purchases in the Orient and the increased production of the metal as a by-product in copper mining.

Physics and Psychology

On another page we publish an elementary account of the scientific principles underlying the process of concentration by froth-flotation. This is written by one who knows little about the subject, but, like many of his readers, is anxious to learn. One way to learn is to ascertain what you don't know. In the case of the new metallurgical process the world of knowledge outside human ken is immense. Our own point of view is sympathetic to that of our readers, to most of whom also the subject is wrapped in obscurity. In the land of the blind, the one-eyed is king. Indeed, our own study of flotation leads us to conclude that those who have had two good eyes for the purpose of technical observation have made their vision violently astigmatic by prejudice. The subject is frothy with the vindictiveness generated from private quarrels and patent litigation. For that

reason most of the published information has to be read with frequent pinches of sodium chloride. Such as they are, the printed writings on flotation concern themselves mainly with the manipulation and apparatus of the subject; usually they ignore the physics involved. When references are made to basic principles, it is in a casual, and misleading, way. For instance, we have found a mention of the effect of oil on surface tension in four articles, and in each case the statement is made that the oil increases the surface tension. It does not. Any book on physics will furnish that elementary information. On the other hand, those patentees that have studied the science of the subject with real insight have written little or nothing on it. Obviously they fear to compromise themselves. The multitudinous articles on the Elmore process, emanating from the friends of the patentees, are devoid of scientific information. So the later articles on the process developed by Elmore's opponents likewise tell next to nothing about the underlying realities. The most recent information is to be found in the trial records, giving the testimony of the experts in the lawsuits, but even these are only distantly related to scientific evidence, for the experts are advocates, not witnesses; they come into court with a bias that renders all they say subject to heavy discount. However, from these and other sources we have gleaned some bits of knowledge that may prove useful to our readers. The flotation pundits will find much that to them seems wrong in our efforts to make a logical presentation of the physical phenomena, or appearances, behind the process. They will be welcome to their feeling of superiority. Not one of them can describe flotation in terms that three others will accept as accurate. Moreover, the recognition of one or two unobtrusive facts might embarrass them when next they take the stand, so we shall excuse them from reading our amateur analysis. It is 'amateur' in the real sense of the word, for it has been a labor of love to make this diagnosis of the effects that unite in giving the miner another means of extending his profitable exploitation. Flotation is a process of extraordinary technical interest. We hope that our article will be a stimulant to investigation and to observation. It may lead others to contribute their views, not the Montagus and the Capulets of the flotation vendetta, but the Mercutios that cry "a plague on both your houses." We refuse to keep silent, or to ask others to keep silent, on the science of a metallurgical process just because it is the victim of litigation. The litigation has been proceeding in various courts for ten years and we have no assurance that it will not last for ten years more. We do not see how the elucidation of the subject can hurt a rightful patent and we do see most clearly how the mining industry is suffering, and will suffer, from the placing of an embargo on technical knowledge. The days of secret processes are gone: they are either patentable and protected by patent, or they are not. The one thing that is clear is that the granting of patents under existing regulations makes only for confusion. A patent should not be given until it has been thoroughly investigated by competent men, and once given it should be protected and regulated by the whole power of the State.

Meanwhile we must take things as they are, recognizing two existing conditions: (1) the hindrances offered to the publication of such knowledge as is available and (2) the incompleteness of that knowledge even when available. Cohesion, surface tension, and viscosity are real but subtle forces, requiring refinements of research such as are rarely provided in a metallurgical laboratory. To be frank, the theory of flotation has not been developed by metallurgists to the point where it is accepted by physicists. To understand it will require painstaking investigation of the nature of liquids—an elusive problem. Even if we could allot to surface tension and to viscosity their respective parts, we should still be in the dark over the preference of the bubbles, as of the oil, for the metallic particles. We have yet to learn what part electro-statics plays. However, if we do not know 'why,' we do know 'how,' for flotation is a fact, no matter how mysterious the physical laws that lurk in the background. In succeeding issues we shall give an account of the history of the process, the present state of the art, and its application to various ores.

The Engineering Congress

Next week San Francisco is to be the place of meeting for the International Engineering Congress of 1915. The movement resulting in this convention began to take definite shape at a meeting of the representatives of the American Societies of Civil and Mechanical Engineers On October 24, 1911, in this city. Those present were Messrs. A. L. Adams, C. Derleth, Jr., G. W. Dickie, C. E. Grunsky, E. C. Jones, and T. W. Ransom. At that meeting it was decided to issue invitations to all the engineering and technical organizations having local sections in San Francisco to send representatives to a meeting on November 2, 1911, to discuss ways and means for accomplishing the purpose designated. At this second meeting eight societies were represented, as follows:

American Society of Civil Engineers,
C. Derleth, Jr., and C. E. Grunsky.

American Society of Mechanical Engineers,
G. W. Dickie and T. W. Ransom.

Pacific Coast Gas Association,
E. C. Jones.

American Institute of Electrical Engineers,
H. A. Lardner.

Mining and Metallurgical Society of America,
F. W. Bradley and S. B. Christy.

American Institute of Mining Engineers,
W. C. Ralston and E. T. Blake.

American Chemical Society,
F. T. Green and B. S. Drake.

Technical Society of the Pacific Coast,
Marsden Manson and Otto von Geldern.

On this occasion a resolution was adopted that each

society should send three delegates to a conference on January 15, 1912, for the purpose of formulating plans for holding the Congress in conjunction with the Panama-Pacific Exposition in San Francisco during the year 1915. At that conference the various societies were represented by the following delegates:

American Society of Civil Engineers,
A. D. Foote, C. D. Marx, and W. A. Cattell.

American Society of Mechanical Engineers,
Calvin W. Rice, W. F. Durand, and E. C. Jones.

Pacific Coast Gas Association,
John A. Britton, C. O. G. Miller, and Frank A. Leach, Jr.

American Society for Testing Materials,
C. B. Wing, Loren E. Hunt, and C. F. Wieland.

Society of Naval Architects and Marine Engineers,
W. F. Durand, F. W. Hibbs, and G. W. Dickie.

Mining and Metallurgical Society of America,
F. W. Bradley, C. W. Merrill, and E. A. Benjamin.

American Institute of Mining Engineers,
W. C. Ralston, Edwin Blake, and S. B. Christy.

American Society of Electrical Engineers,
H. A. Lardner, S. J. Lisberger, and G. R. Murphy.

Technical Society of the Pacific Coast,
Otto von Geldern, Marsden Manson, and Col. W. H. Heuer.

Thereupon it was finally decided that a Congress be convened under the auspices of five national engineering societies, namely:

American Society of Civil Engineers.

American Institute of Mining Engineers.

American Society of Mechanical Engineers.

American Institute of Electrical Engineers.

Society of Naval Architects and Marine Engineers.

It was arranged also that the Congress should be managed by a committee consisting of the presidents and secretaries of the five societies and four other members of each society to be duly appointed. This was approved by each of the societies. On March 6, 1913, the local members of the Committee of Management met in the board-room of the Mechanics Institute for the purpose of perfecting the organization. On that occasion Professor Durand was elected chairman, Mr. W. A. Cattell, secretary, and a committee was appointed consisting, in addition to the two mentioned, of Messrs. E. H. Benjamin, W. G. Dodd, A. M. Hunt, and T. W. Ransom, to formulate a plan of organization and nominate permanent officers.

In order to secure national support, it became necessary for the engineers of the Pacific Coast to show their faith in the project by subscribing to the guarantee fund of $10,000. This was done, so that when the official representatives of the Five Societies assembled on March 6, 1913, the $10,000 had been fully subscribed.

On March 14 the plan of organization, together with the constitution and by-laws for the government of the Committee, was adopted, the temporary appointments of chairman and secretary being made permanent. Thereafter the work of preparing for the Congress was started in earnest, Mr. E. J. Dupuy being retained as executive secretary. The fund guaranteeing the expenses of the Congress was underwritten as follows:

Engineers of the Pacific Coast	$10,000
American Society of Civil Engineers	9,000
American Institute of Mining Engineers	5,000
American Society of Mechanical Engineers	5,000
American Institute of Electrical Engineers	5,000
Society of Naval Architects and Marine Engineers	2,000

The amounts underwritten by the various societies were proportional to their respective memberships.

Delegates to the Congress have been appointed by 29 societies and 5 Government departments:

United States	10	Hungary	1
Great Britain	9	Spain	1
France	2	South Africa	1
Canada	1	Argentine	1
Sweden	1	Netherlands	1
Switzerland	1		

Papers have been received in large number: from the United States, 158; France, 6; England, 14; India, 3; Italy, 9; Netherlands, 5; Canada, 5; Spain, 2; Sweden, 2; Russia, 2; South Africa, 1; Australia, 2; Japan, 4; China, 2; Switzerland, 2; Austria, 1; Argentine, 2; and Chile, 1.

Subscriptions to membership number 3082, of which 816 are in foreign countries. The five societies contributed from their membership as follows:

American Society of Civil Engineers	811	or 10.5%
American Society of Mechanical Engineers	458	7.5
American Institute of Electrical Engineers	403	5.3
American Institute of Mining Engineers	360	7.2
Society of Naval Architects and Marine Engineers	69	8.3

Advance copies of the papers to be presented at the Congress indicate that a wide field of knowledge will be fittingly covered. A large mass of useful information will be compiled. Even more important will be the opportunity given the exponents of the various branches of engineering to make acquaintance and compare notes. Representation at the Congress will not be international to the extent desired, for the organized calamity in Europe will have prevented many of the representatives of trans-Atlantic technology from coming hither at this time. South America and Canada will be well represented, so that the attendance of the Engineering Congress will be largely American, although many papers have been contributed by foreign engineers. Well, America is a continent, large and diversified, on which engineering has played so glorious a part that for a day or two we can try to forget the destructive use of applied science by our friends across the sea. Nor need we feel like Nero fiddling while Rome is burning, for engineering, in the main, is constructive; when Peace prevails once more, all the resources of the profession will be organized to restore and rehabilitate the regions now devastated by War. Engineering is synonymous with material civilization. The professional idea connotes the ethical progress of humanity.

The Exposition—An Impression

By T. A. RICKARD

When Vasco Nuñez de Balboa stood lone upon a peak in Darien, four hundred years ago, and looked upon the western sea, he broke the trail for the builders of the Panama Canal. On August 5, 1775, Juan de Ayala sailed into the Bay of San Francisco, and the fabled land of California became a fact. On July 9, 1846, the American flag was raised in the plaza of the Spanish mission settlement. On February 4, 1915, the piercing of the isthmus by an American-built canal was celebrated in appropriate fashion on the shore of the Golden Gate. The dates, even to the days of the month, emphasize the human limitation of time and the immortal glory of each achievement. The past of California is as fragrant with romance as a portico entwined with jessamine in an April twilight. So is the present, to those attuned. Color is in the eye, romance in the imagination. I am standing on the shoreward steps of the Court of the Universe in this great city of palaces called the Exposition; right and left are noble colonnades extending east and west until they merge in domes and towers innumerable; in front, shoreward, is the great court peopled with statues that are eloquent in allegory; its spacious magnificence softened by a parterre of rhododendrons in lavish bloom and by the pigeons that have made their home among the cornices. The Tower of Jewels flashes in the sunlight and through the great arch underneath I can see the environs of San Francisco, a hillside white and purple with houses and foliage, a Sicilian background under a Sicilian sky. Indeed the color is that of the sunny shores of the Mediterranean.

The prevailing tint is golden sienna, for the structures are faced with travertine, like that of Rome. Not new, but old, they look; not tinselled, but mellow; worn by age, as in Italy; a composite of particles of varying color, giving a richness that the sunlight bathes in glory. The scheme of coloring is superb. The domes are variously terra cotta, pale green, and orange. Behind the colonnades I see glimpses of a pink background, while the vaulted ceilings are deep blue in contrast with the yellow in the travertine of the walls and columns. Nothing has been half-done. The detail of adornment is so lavish as almost to be florid. The statuary is original, audacious, and symbolic. Urns and vases in verde antique are distributed among trees, shrubbery, and flowers. These give a setting that escapes artificiality. Nowhere except in such a climate and under such a sky could the general architectural effect be possible. It is the glory of the antique world on the Aegean shore.

When you are tired of wandering down the long aisles of the buildings and the broad avenues outside them, go to the Marina or water-front and give the tired senses an opportunity to rest on the panorama of land and water. This is an exposition in itself, but one that will not fade. The quiet Bay narrows to the Golden Gate, that portal of undying romance. The white house on the island of Alcatraz looks like a palace on Mitylene. The blue hills of Angel island and the verdant cliffs of Sausalito on the opposite shore frame the sunlit waters. Above the nearer hills rises the dark peak of Tamalpais. In the foreground is a battleship. It is the *Oregon*, quietly at anchor, as if to remind us of the part she played in the sequence of events that has been crowned with this Exposition. Indeed she is the *raison d'etre*. When war with Spain was impending in the spring of 1898 she left San Francisco, under the command of Capt. Charles E. Clark. When she reached the southern end of the double American continent, the United States had declared war. We wondered whether she would be intercepted by the enemy's cruisers or whether she could arrive in time to join the American fleet in a naval battle off Cuba. The *Oregon* left San Francisco on March 19, reached Puntas Arenas on April 21, Rio Janeiro April 30, and Key West on May 26, doing 14,000 miles in 68 days, just in time to take her part in the battle off Santiago. It was an object lesson to the Navy Department and to the Nation. If the fleet was to be available for prompt defence on either coast, it was essential to lessen this 14,000 miles by a short cut through the isthmus linking the two American continents. It has been done, and the *Oregon* is moored out yonder in the Bay as if to remind us of the accomplished fact.

At night the lighting of the Exposition is effected with all the startling beauty that electricity has placed in the hands of man. To many visitors the loveliest memory of their sojourn here will be the Fine Arts Palace as seen in the early evening when the twilight joins with artificial lighting in weaving a spell that conquers time and place. A lagoon, fringed with cypress and other evergreens, makes a foreground for the double colonnades that stand like a temple not made with hands. They are dimly lighted. We walk toward a noble perspective, getting unexpected glimpses of columns and statues, water, and flowers. The beauty of line and color is repeated on the still face of the lagoon, where, on an island, a kneeling goddess feeds the sacrificial flame. The searchlight throws its penciled ray athwart the scene. Suddenly, aloft, on the top of a giant column, in mid-air, I see the mighty forearm and shoulder of the Adventurous Archer, who, with feet firmly planted, is sending an arrow into the unknown. The sudden illumination of this heroic and eloquent figure is bizarre but impressive. There he stands as the

symbol of the pioneering spirit, shooting across the water, into the unknown, at a venture, while Hope kneeling at his side seconds his strength with sympathy.

The picture is ephemeral! A year hence it will be gone. The Exposition covers 600 acres and on it has been spent $50,000,000 in the erection of buildings and the assembling of exhibits. Not many months ago the site consisted of sand-dunes and marshes, varied by the shanties of a neglected foreshore. A small part of the Exposition is built on the Presidio, the military reservation dating from historic days. Early next year all these lordly palaces of art and industry will be 'wrecked' systematically, every broken part of them will be removed, so that the streets and alleys of an unlovely suburb may be restored. The dream will become a memory.

It is indeed the fabric of a dream, the dream that came true. And like a vision at the dawn of day it must fade. That pathetic thought is ever present. From sand-dunes and marshes it sprang; into them it will disappear.

But while the physical part of this Exposition is ephemeral, the spirit of it will not pass immediately. Among the millions that come and go, whether staring half-intelligently or observing with real insight, there will be many to whom the splendor of the scene and the beauty of the vision will be an abiding memory. On them the allegory of the statuary will not be lost, on them the message of the artist will not be wasted. And the fact that most of them came from the outworks of an intensely industrial civilization will make the psychical effect all the greater. It is well for men to learn that they do not live on bread alone; it is well for them to endeavor to industrialize their lives without also commercializing their souls.

Production of Gold and Silver

The Bureau of the Mint and the Geological Survey completed their joint calculation of the production of gold and silver in the United States for the calendar year 1914, and the figures are given below:

The decrease in gold production was mainly in two states—Nevada, $441,200, and Utah, $193,300—while the increases were as follows: Colorado, $1,792,700; Alaska, $1,345,900; California, $1,010,600; Montana, $822,700.

The largest gain in silver was in Idaho—3,096,700 oz.

	Gold.		Silver.	
State or Territory.	Fine oz.	Value.	Fine oz.	Value.
Alabama	595	$ 12,300	300	$ 200
Alaska	800,471	16,547,200	865,900	478,800
Arizona	221,020	4,568,900	4,439,500	2,455,000
California	1,028,061	21,251,900	2,020,800	1,117,500
Colorado	962,779	19,902,400	8,804,400	4,868,800
Georgia	813	16,800	100	100
Idaho	57,431	1,187,200	12,573,800	6,953,300
Illinois	.....	.....	1,900	1,200
Maryland	10	200	100	100
Michigan	.....	.....	415,500	229,800
Missouri	.....	.....	60,000	33,200
Montana	200,446	4,143,600	12,536,700	6,932,800
Nevada	558,064	11,536,200	15,877,200	8,780,100
New Mexico	58,974	1,219,100	1,771,300	979,500
North Carolina	6,303	130,300	1,500	800
Oklahoma	.....	.....	6,200	3,400
Oregon	76,887	1,589,400	147,400	81,500
Philippine Islands	53,179	1,099,300	10,300	5,700
Porto Rico	135	2,800	.....	.....
South Carolina	155	3,200	.....	.....
South Dakota	354,782	7,334,000	179,800	99,400
Tennessee	309	6,400	102,800	56,800
Texas	426	8,800	574,700	317,800
Utah	163,362	3,377,000	11,722,000	6,482,300
Virginia	15	300	1,500	800
Washington	28,435	587,800	341,300	188,700
Wyoming	324	6,700	100	100
Total	4,572,976	$94,531,800	72,455,100	$40,067,700

The production of gold was greater by $5,647,400 than in 1913, and the production of silver was $5,653,600 fine ounces greater.

California gained 599,300 oz.; Arizona, 527,500 oz.; Alaska, 499,200 oz.; and Utah, 439,700 ounces. California was first in gold, and Nevada in silver production.

What Is Flotation?

By T. A. RICKARD

Flotation, in its latest phase, is a process of concentrating ores by frothing. When crushed ore, previously mixed with water and a relatively minute addition of oil, is agitated violently in the presence of air, a froth is formed. This froth, rising to the surface of the liquid mixture, is laden with sulphides or other metallic particles, while the earthy material, or gangue, subsides to the bottom. This froth is "thick, coherent, and persistent."

The formation of this froth depends upon a number of physical causes, of which the buoyancy of oil is the one most generally associated with the flotation process. Surface tension, however, is the phenomenon to be considered first. Then viscosity.

Every millman has had occasion to notice how sulphides are carried on the surface of wash-water in a

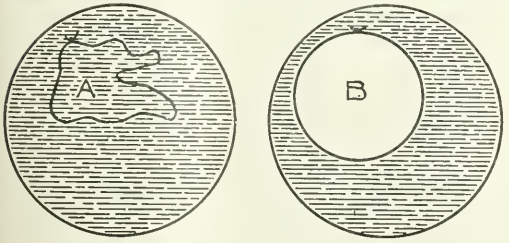


Fig. 1.

stamp-mill: for example, when water is passed over the dry surface of an amalgamating-table or a vanner-belt. The metallic particles are dry and to their surfaces is attached a film of air that buoys them on the water. To a similar cause is due the loss of 'float gold' in tailing. Most of us learned early that grease of any kind was bad for amalgamation. It 'sickens' the quicksilver, coating the globules so that they do not coalesce but remain in a 'floured' or minutely globular condition. This may account for the loss of quicksilver, but the further loss of gold must be imputed to the fact that the fine scaly bright gold attaches itself readily to the oiled spheres of mercury and is carried with them into the creek.

The surface of any liquid behaves as if it had a film or elastic skin. To this fact is due the variation in the maximum size of drops of different liquids. As the drop enlarges, the strength of this skin is exceeded; then the drop breaks and the liquid falls. When an iron ring is dipped into a solution of soap, it will be seen, on taking it out, that a film of the liquid stretches across the ring. If a small loop of cotton, previously moistened with the solution, is placed on the film left on the ring, this loop can be made to assume, and retain, any form, such as is shown at *A* in Fig. 1. If, however, the film within the loop is broken, the loop immediately assumes the circular form, shown at *B*; and if it is now deformed in any way, on being released it springs back at once to a circle.

These phenomena indicate that the particles at the surface of a liquid have a greater coherence than the particles in the interior of the liquid. The force that does this is surface tension. The experiment with the ring and the loop, for example, is explained by the fact that, in the first place, "the surface tension of the liquid acts equally on both sides of the cotton, but when the film inside the loop is broken, the surface tension only acts on one side, and hence draws the loop out into a circle."*

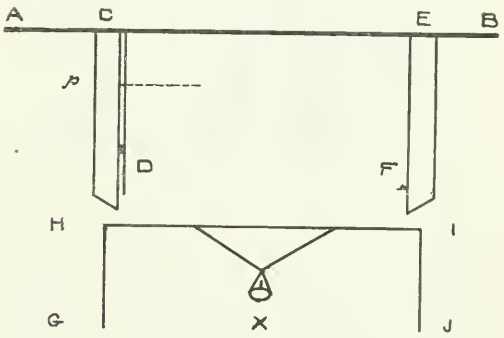


Fig. 2.

Surface tension can be measured. A framework[1] (Fig. 2) consisting of a transverse bar *A B*, and two grooved slips *C D* and *E F*, will allow the piece of wire *G H I J* to slip freely up and down. The wire *H I* is pushed against *A B* and a quantity of the liquid is applied between them. The little pan *X* is loaded with sand until the wire *H I* is pulled from *A B*. The minimum force required to do this is *mg*, the weight of *m* grams. This weight suspended on the film equals the tension of the film on the wire. If the film stretches until the wire *H I* is at *p*, then the film has an area *C E.Cp*. The total weight *mg* is distributed over the breadth *C E*; whence, if *T* represents the superficial tension across the unit of length *C E*, then $mg = T.C\,E$ or $T = \frac{mg}{C\,E}$.

Thus the force of surface tension between water and air has been determined; it is 3¼ grams per linear inch or 81 dynes per centimetre, which being interpreted means that 40 grains would be supported by a film one foot long.

*'A Text-Book of Physics,' by W. Watson, page 191.

[1]'A Text Book of the Principles of Physics,' by Alfred Danniell, 1911.

The surface tension of various liquids is as follows:

Liquid.	Sp. Gr.	Tension of surface separating the liquid from Air.	Water.
Water	1.00	81	....
Mercury	13.54	540	418
Alcohol	0.79	25.5	....
Olive oil	0.91	36.9	20.56
Turpentine	0.88	29.7	11.55
Petroleum	0.79	31.7	27.8

These are given in dynes per centimetre as determined by Quincke, and recorded in the Encyclopedia Britannica. However, a liquid has another characteristic that must not be overlooked, namely, viscosity or resistance to flow. This gives toughness to the superficial film. Water-spiders will run over the surface of a pool like boys on skates over thin ice. The spider's feet do not break through, although each tread makes a dimple on the surface. H. H. Dixon actually measured the pressure exerted by the spider's feet on the water. He photographed the shadow of the dimple and then mounted one of the spider's feet on a delicate balance and made it press on the water until it made a dimple of the same depth as that previously observed.

The next phase of the subject is illustrated by the familiar experiment with a greased needle. If you place an ordinary needle, say, a lace needle suitable for use with No. 80 thread, on the surface of a bowl of water, it sinks at once to the bottom, in obedience to the law of gravity. If, however, you pass the needle through your hair,[2] so that it becomes greased, it will float on the water. Why the difference of behavior? In its ordinary state the needle has a film of air attached to it. That film, being loosely held, is readily displaced by the water, so that the needle becomes wetted, that is, its weight causes it to break through the elastic skin constituting the surface of the water. On the other hand, when the needle is greased, the film of air around it is displaced by a film of oil, which is firmly held, because lustrous metallic surfaces have a selective adhesion for oil. Moreover, gases have a marked adhesiveness for oils, so that air adheres readily to the film of oil on the needle. On account of this envelope of oil and air, the needle is not wetted, that is, it fails to rupture the surface. The needle lies in a depression in the surface of the water, but the amount of displacement does not account for the floating. Viscosity, however, may play a part, by increasing the tenacity of the film, the particles of which are so held together, or cohere, that the needle fails to part them. In short, although it is eight times heavier than water, the steel floats.

Another suggestive experiment is that of the grapes in soda-water. Fill a glass two-thirds full with soda-water from an ordinary 'syphon' and then drop two or three small grapes into it. The grapes sink to the bottom, but they become restless almost immediately and soon rise to the surface, one after the other. They do not remain there; first one and then the other sinks. This performance will continue for half an hour, the individual grapes rising and falling, not always the whole way, but maintaining a condition of intermittent activity. They become quiet only when bubbles cease to be generated at the bottom, that is, when the carbonic acid gas has been driven out of the water by the relief of pressure. By watching, it is seen that the bubbles attach themselves to the grapes and buoy them to the surface, where the bubbles break. Sometimes a couple of grapes will collide and cause the adhering bubbles to become detached, so that one or both of the grapes sink. In the end the bubbles become too few to buoy the grapes, so that the latter rise only part of the way; finally, they lie motionless at the bottom. During the early and active part of the performance, the grape will strike the surface of the water and rebound from it as if it were a membrane.

The buoyancy of oil is the physical fact most associated with the first development of flotation, although it is subordinated in the later phases of the process. Oil has a specific gravity less than that of water, and therefore rises to the surface when mixed with water. The lighter oils range in specific gravity from 0.8 to 0.95, as against the 1.0 of water, so that the margin for buoying particles heavier than water is small. For instance, to make a mixture of zinc sulphide and oil as light as water, it would be necessary, even with the lighter oils, to use from 3 to 15 times as much oil by weight as the blende. This suggests that flotation, even as conducted on the lines of the older patented processes, cannot be due entirely to the buoyancy of oil.

The selective adhesion of oil for particles having a metallic lustre is a decisive factor in the process. It has been said that this adhesiveness is characteristic of sulphides; but it is exhibited by tellurides and by graphite also. Similarly, it has been imputed to 'mineral' and to 'metallic'[3] particles, but both terms would include substances outside the range of this phenomenon. Apparently it is the metallic lustre that is the decisive factor, for this would include the minerals especially amenable, such as molybdenite, graphite, the tellurides, and the bright sulphides. The effect of this marked preference of oil for lustrous metallic surfaces is intensified by the fact that gases (such as air) have a similar adhesiveness for oil, so that, if present in water, they will join in preventing the wetting of the metallic surfaces. It is an equally important fact that quartz and other gangue-minerals, having a 'non-metallic' as against a 'metallic' lustre, exhibit the opposite preference: they are feebly adhesive to films of oil, and therefore to those of gas, while they are strongly adhesive to water, that is, they are easily wetted. The reason for this difference is not known; it may belong to the, as yet, mysterious realm of electro-statics, but it is a fact that the curve of con-

[2]Or even through your fingers.

[3]'Metallic,' in this context may mean minerals with a metallic lustre, including graphite, and 'mineral' may be meant in the sense of ore, the valuable part of the vein or lode, as distinguished from the worthless earthy matter or gangue. In French, *minerai* means 'ore.' Sometimes 'sulphide' is preferred, but that excludes the tellurides and graphite. At least one sulphide without metallic lustre is readily amenable to flotation, namely, cinnabar.

tact, or wall-angle, between metallic particles and water is convex while that between earthy particles is concave.

Whatever the reason for this difference, it can be accentuated by acidulation of the water. "Acidified water has a greater wetting power than neutral water." For this fact also no satisfactory explanation is forthcoming. In some cases, the acid may be supposed to dissolve any coating of oxide on the metallic surface, rendering it more lustrous, while on the other hand, the acidity of the water may give it a corrosive penetration beneath the surface of the gangue.

The addition of acid in quantity produces another effect, namely, effervescence or the liberation of carbonic acid gas by the reaction with calcite, rhodochrosite, or other carbonates such as are often present in the ore. This generates bubbles that will buoy the metallic particles, whether oiled or not. But water contains air in solution; hence by heating the water, or by diminishing the pressure, it is possible to release the air in the form of bubbles that attach themselves to the metallic particles, like the bladders used by persons learning to swim. Moreover, by a violent agitation of the mixture of ore, water, and oil (if added) it becomes easy to entrain or entangle a large volume of air, which will rise through the mass in the form of myriad bubbles, constituting a foam or froth of varying strength and persistence.

Oil reduces the surface tension of water, that is, between water and air. Pure water has great surface tension, it also has no superficial viscosity; that is why it will not froth. The addition of oil lowers the surface tension and imparts a decided viscosity to the surface of the water. That is why the pouring of oil on troubled waters abates their turbulence. That also explains why the placing of oil in stagnant pools kills the larvae of the mosquito, which then find it impossible to adhere to the surface by their breathing-tubes. (See Fig. 3.)

Consider the beautiful soap-bubble. The oil of the soap is an impurity that lowers the surface tension of the water; by stretching of the film of the bubble this effect is diminished through the dilution of the impurity, making the film stronger and less prone to contract.[4] Thus it renders the bubble more persistent. The bubble therefore is another illustration of surface tension, for it is an elastic skin of water enclosing gas, like a balloon. Here also the property of viscosity comes into play, for the addition of oil to the water, more particularly after exposure to the air, as in agitation, gives tenacity to the superficial film. The combination of low tension and high viscosity enables a bubble of gas, rising through the liquid, to lift the surface film of the liquid, which the tension of the bubble-film is not strong enough to break, so that the bubble endures.[5] The noise made by the bursting of a bubble suggests the fact that it is a receptacle of energy.

The bubble is spherical because the sphere is the shape involving the smallest surface or superficial area. The bubble has an affinity for the lustrous metallic particles and adheres to them, as it also adheres to the smooth sides of a glass. This particle of air, or other gas, is enveloped in an elastic skin of the contaminated viscous liquid in which it has been generated and the metallic particles do not break through that skin for the same reason as the greased needle failed to be drowned in the water.

The addition of soluble oils assists the formation of bubbles in the mass of ore and water. These three constituents of the flotation pulp are mixed intimately so as to form an 'emulsion,' such as is typified by mayonnaise. The air present while the emulsion is being made furnishes the gas for the bubbles. In order that they may lift the metallic particles, they must endure during the

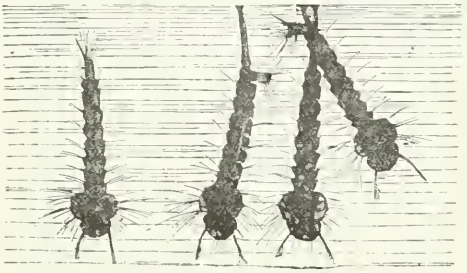


FIG. 3. LARVAE OF MOSQUITO UNDER THE MICROSCOPE.

period required for the complete separation of the metallic particles from the earthy particles, that is, the sorting of the valuable from the non-valuable components of the ore. For the purpose of metallurgical concentration the rate at which the bubbles burst must be slower than that at which they are being formed. An effective froth represents a multiplicity of persistent bubbles. The relative stability of the bubbles depends also upon the kind of oil employed. Pine-oil makes a brittle film; creosote yields an elastic envelope.

By a wonderful correlation of physical forces, the metallic particles become attached to the bubble, made in the metallurgical emulsion, in such a way as to serve as a protective armor, the particles of varying size interlocking on its spherical envelope. The bubbles without mineral are like a balloon with a weak gas-bag, which is likely to burst, while the armored bubbles are like a balloon with a strong gas-bag, which does not burst. Variety of size among the metallic particles favors the construction of the interlocking mineral coat on the bubble, just as materials of various size help to make a dense concrete. Hence slime is no hindrance.

Intimate mixing is required. The more thorough the mixing, the cleaner the separation of the metallic from the earthy particles. This is said to be due to the complete oiling of the metallic particles, but it is a fact that no oil can be discerned on the concentrate when using the $\frac{1}{3}$ to $\frac{1}{2}$ pound of oil per ton sufficient in most cases for the purpose of the process. The mixing may be beneficial for reasons other than the oiling of the con-

[4] C. V. Boys, 'Soap Bubbles,' page 105.

[5] Danniell, *Op. cit.*, page 278.

centratable parts of the ore; it may cause enough friction to clean the metallic surface; it may promote such a solution of the oil in the water as ensures the formation of the right kind of bubbles for a mineral-carrying froth. Heat, by the injection of steam, increases the miscibility, or ability to be mixed, of the oil, thinning it so that it will extend over a larger surface, as butter is warmed to make it spread over pop-corn. Many common oils, such as 'red oil' and other forms of oleic acid, are solid at the ordinary temperature, so that heat sufficient to raise the temperature of the emulsified pulp to about 80° F. is desirable.

To apply this process of concentration, the ore is crushed to the degree of fineness required to separate the metallic minerals from the earthy gangue. This may mean anything from 40 to 200-mesh. The crushed ore is then mixed with water in the ratio, say, of 3:1, although theoretically 2:1 would make a better emulsion; oil is added, say, in the proportion of ½ lb. per ton of ore; and the mixture is agitated violently in the presence of air, by paddles or beaters, by passage through a centrifugal pump, or by jets of compressed air. Acid is not necessary, as we now know,[6] although it has heretofore been considered requisite. Whether oil is absolutely essential is open to doubt. Agitation of the pulp in the presence of air is the prime factor in producing the desideratum, namely, a froth. What machines are best adapted to ensure proper agitation is a matter for separate consideration. Aeration of a liquid by agitation in the presence of air and forcing of the air into it so as to form multitudinous small bubbles, producing a froth, is done every day in the domestic operations of the beating of eggs and the whipping of cream.

We have now got our froth. This, as it accumulates on the surface of the emulsified pulp, may be from 2 or 3 inches up to 10 or 15 inches thick. It is so densely coated with the sulphides as to be black, while the gangue that falls to the bottom is so clean as to be white. By skimming, using radial arms or scrapers, or a simple flow, the froth is removed to a secondary receptacle or 'cell,' of the spitzkasten or V-shaped type, where it is cleaned by a repetition of the process, making a high-grade concentrate, while the discard goes back for retreatment. In short, all that is needed is some arrangement for thorough mixing and aeration, by the use of paddles or air under pressure; then the removal of the resulting froth so that the floated mineral will not drop when the bubbles break. When the froth has been collected, it is filtered, yielding a cake containing about 10% moisture, which may be dried before shipment or final treatment for the extraction of the precious metals.

CORRECTION. Our attention has been drawn to a slight error in the article on flotation at Anaconda. The dimensions of the Hardinge mills are reversed; they, of course, are not 10 ft. diam. by 4 ft. long, but 4 ft. diam. and 10 ft. long.

[6] 'Flotation in a Mexican Mill,' M. & S. P., July 24, 1915, page 123. Also Charles Butters, M. & S. P., August 21, 1915.

Magnetic Surveying

A magnetometer was used in surveying an area containing nickeliferous pyrrhotite where more or less complete data had already been secured by diamond-drilling. It was thus possible to compare the evidences of mineralization, as indicated by the magnetometer, with the actual conditions as previously determined. The results of this work indicate that, when the orebodies are fairly uniform in character and composition, the magnetometer will be of assistance, both in extending the known boundaries of deposits already recognized, and also in determining the existence and general extent of new deposits. It would thus appear that exploration by means of magnetometric surveys may also be extended to any other ore deposits in which magnetite or pyrrhotite is known to be an accompanying accessory mineral. The conclusion arrived at in regard to the applicability of the method in exploring for copper and nickel deposits on Texada island, British Columbia, is as follows: In places where the formation is covered with swamps and drifts, the approximate position of pyrrhotite deposits can be determined. It should be remembered, however, that as it is not the pyrrhotite itself but the minerals associated with it, namely, copper pyrite and pentlandite, which make up the chief value of the ore, and as the proportion of these minerals as compared with the pyrrhotite varies considerably, the amount of copper and nickel may be low even when a strong magnetic field is obtained. Hence the discovery of magnetic attraction is by no means to be considered as absolute proof of the existence of a deposit of workable ore. A steady and continuous attraction, though weak, is a good indication that an orebody may be found. Having ascertained the approximate location of a magnetic body by a magnetometric survey, diamond-drilling or some other method of exploring must be used in order to ascertain the quality and character of the deposit. This instrument, which is exhibited in the Swedish Pavilion at the Exposition, has been successfully employed in investigating buried gravel deposits.

A MINERALOGICAL joke was played on a mining engineer during his visit to Korea. Perhaps his assumption of superior wisdom irritated the junior members of the staff of the mine that he was examining. After he had finished his soup the next course was brought on—pieces of something that looked like smoked halibut. He was just going to take a piece from the large platter, held by the deferential Korean servant, when the assistant superintendent, a slender and innocent-appearing Australian, asked: "What do you think that is?" "Some sort of smoked fish," replied the visitor. But to his surprise the fork refused to penetrate the supposed fish, and a closer examination showed that it was a specimen of 'mountain leather,' or asbestos.

No. 1 AND 2 SHAFTS at the Centennial mine, Michigan, were up and down draft, respectively. A fire in No. 2 caused a reversal of draft. This was lucky, or the shaft would have been burned to the bottom.

Aluminum Precipitation at the Mill of the Butters Divisadero Company

By E. M. HAMILTON and P. H. CRAWFORD

Introductory. Before proceeding with the main subject of our article it may be of interest if we give a short summary of the history of aluminum precipitation.

In 1893 Carl Moldenhauer patented the use of aluminum as a precipitant for gold and silver from cyanide solutions, but does not appear to have followed up his idea on a practical scale.

In the same year H. F. Julian experimented with it in the form of plates set vertically in a box, and also in the form of filaments or shavings, but the attempt was not successful, because alumina deposited on the metallic surfaces and stopped all further action.

In 1910 S. F. Kirkpatrick conceived the idea of using the metal in the form of dust and thus avoided Julian's difficulty in regard to the coating of the metallic surfaces with alumina; because in the case of the dust the metal particles are entirely dissolved before any such protecting action can take place.

The fact that aluminum does not replace the precious metals in the cyanogen compound renders necessary the presence of caustic soda or potash, the reaction probably occurring theoretically thus:

$$6NaAgCy_2 + 6NaOH + 2Al = 6Ag + 12NaCy + 2Al(OH)_3$$

The aluminum hydroxide at once dissolves in the excess of caustic to form sodium aluminate,

$$2Al(OH)_3 + 2NaOH = Na_2Al_2O_4 + 4H_2O$$

If this explanation be the correct one it should be possible to make one part of aluminum precipitate 12 times its weight of silver, but in practice the amount is more like 3 times its weight only, so for low-grade solution when caustic and aluminum are both present in excess, the following may more nearly represent what actually goes on:

$$2NaAgCy_2 + 4NaOH + 2Al = 4NaCy + 2Ag + Na_2Al_2O_4 + 4H$$

A description by Hamilton of the introduction of the process at the Nipissing low-grade-ore mill was published in the *Engineering and Mining Journal* of May 10, 1913. It was adopted at that mill at the time of its starting in November 1912, because it was found that with zinc precipitation the zinc taken into the stock solution formed with the arsenic present in the ore a combination inimical to the dissolution of the silver, the substitution of aluminum for zinc showing an increase in extraction of over 4 oz. silver per ton. Since that time its use has been continued with entirely satisfactory results.

In August 1914, G. H. Clevenger presented to the American Institute of Mining Engineers a paper reviewing Hamilton's original article and criticizing certain points in it, to which the latter replied in an article in the *Engineering and Mining Journal* of March 27, 1915. The most important question raised by Clevenger was: "Is the aluminum dust process likely to result in a greater final profit than the use of zinc, at mills where zinc in solution is no detriment to a high silver extraction?" This Hamilton tried to answer in the affirmative, by showing that for a 10-oz. silver ore the additional cost of the process over zinc should not be more than 1c. per ton, against which would be set a saving in cyanide of greater or less amount. Clevenger questioned such a saving on the ground that all or most of the zinc-potassium cyanide formed in the zinc process was subsequently regenerated and rendered available for doing work, and, on the contrary, even suggested a loss of cyanide in the aluminum process due to adsorption by precipitated aluminum hydroxide.

Hamilton, while admitting that a variable amount of the zinc double cyanide formed in the zinc process is usually regenerated later on, denied that anywhere near all of it was so rendered available, the proportion not regenerated forming a measure of the cyanide that might be saved by substituting the aluminum process. He also expressed the opinion that while the adsorption of soluble salts by colloidal substances was an acknowledged fact, yet that the figures at the Nipissing indicated that in practice this tendency was small enough to be negligible, probably because, on account of a high caustic content in the solution, aluminum hydroxide was not precipitated, though there was some precipitation of aluminum as calcium aluminate by the small amount of lime added in the mill.

He agreed with his critic that a full-sized working test of the two processes under similar conditions would be the only way to settle the theoretical questions raised, and the present article is designed to give an account of such a test, made at the mill of the Butters Divisadero Company.

Conditions. It should be stated at starting that the ore being treated at this mill is not one of those in the cyaniding of which zinc in solution is detrimental to extraction, so that the chief advantage to be derived from the introduction of aluminum precipitation lay in the possible saving of cyanide by its use. The assay-value is low, being about $2 in gold and 7 oz. in silver, and as 1 oz. of silver combines with alkaline cyanide to the amount of 0.08 lb. KCy or 0.06 lb. NaCy it will be seen that at this mill the conditions are not as favorable as they might be for displaying the capabilities of the process in the economy of cyanide.

When we began experimenting with a view to its introduction at the Divisadero mill we soon found that some modification in the system used at Nipissing would be necessary in order to make it applicable to this ore, and probably also to the majority of other ores.

It may be well here to remind our readers of the conditions that obtain at Nipissing. The ore is crushed in caustic soda solution in preparation for the desulphurizing process. About 5 lb. of lime per ton is added in the battery to obtain the preliminary settlement of the slime, but most of this is soon thrown out as calcium aluminate by the sodium aluminate in the mill solution, derived from this process. The pulp is then filtered, and, without any water-wash, is discharged, and re-pulped with cyanide solution, agitation following in the usual manner. When treatment is finished the slime settles without trouble, although hardly a trace of lime is left in solution at this stage.

The first condition with which we had to contend at Divisadero was the acidity of the ore, the lime consumption being 30 lb. of high-grade lime per ton. As stated in Hamilton's original article, it is essential that lime shall be absent from solution at the time of precipitation, because it reacts with the sodium aluminate and is precipitated in the press as calcium aluminate, yielding at the clean-up a product that it is almost impossible to melt. The cost of substituting caustic soda for lime as a neutralizer would have been prohibitive, while the plausible alternative of adding just the right amount of lime to insure its being all neutralized by the time the ore-treatment was finished had the drawback that, though neutralized, it would not necessarily all be removed, because calcium sulphate is rather more soluble in water than the hydroxide, and would be equally precipitated by sodium aluminate should it reach the precipitation system.

The second condition that made the Nipissing process inapplicable here was the fact that the slime would not settle satisfactorily without an adequate quantity of lime in solution at the close of ore-treatment, whereas, at the Nipissing, as already stated, the final settlement takes place without trouble in the absence of lime.

New Method. To overcome these difficulties Hamilton devised the plan of treating the solution before precipitation with soda ash, thus throwing out the lime as carbonate and substituting caustic soda therefor:

$$Ca(OH)_2 + Na_2CO_3 = CaCO_3 + 2NaOH$$
$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$$

After several months experimenting on a large scale we succeeded in developing this idea into a smoothly working process,* which at the time of writing has been running six months and gives entire satisfaction. It allows us to use all the lime necessary for neutralizing and settlement, it yields a lime-free solution for precipitation, and incidentally manufactures the caustic soda necessary for that operation, in accordance with the formula, given above.

The idea at first was to add the soda ash to the slime charge at the end of agitation, so that the precipitate of calcium carbonate might be filtered out with the gangue, avoiding a separate operation; but owing to the slow settlement of the slime, caused by the absence of lime, this plan was abandoned, and it was decided to separate the lime from the clear solution just before precipitation of the gold and silver.

The solution derived from slime treatment, including that decanted before filtration and also the effluent from the Butters filter, amounts to four times the weight of slime treated, and is all precipitated, but part of it is first used for the treatment of the sand in the leaching plant and by this considerably enriched in gold and silver. As the ratio of sand to slime is about 1 : 1 the ratio of solution precipitated to ore milled is 2 or 2.5 : 1. The method of operation is as follows: The pregnant solution is pumped to a tank of 100 tons capacity, above the plant, fitted with a mechanical stirring-gear, and it is here that the soda ash is added. In order to find out exactly how much of the latter is needed, a simple test is employed. A standard solution of the soda ash is prepared by dissolving 6.25 grams in distilled water and making up to 1 litre, and is such that if 50 c.c. of pregnant solution be taken for the test, each cubic centimetre of soda ash solution will be equivalent to $\frac{1}{4}$ lb. of the dry salt per ton of cyanide solution. A portion of the solution to be tested is filtered, and 50 c.c. measured and placed in an Erlenmeyer flask or small beaker and heated over an alcohol lamp until almost too hot to hold in the fingers. A measured quantity, say, 2 c.c. of the soda ash solution is then drawn from a burette and agitated for a few minutes to insure complete precipitation. The contents of the flask are filtered, and the filtrate divided into two parts; to the first part is added a few drops of potassium oxalate solution, and if any turbidity results it indicates an insufficiency of soda ash. In that event a fresh portion of the original solution is taken and the test repeated, increasing the soda ash to 2.5 or 3 c.c., filtering, and testing with oxalate as before. This operation is repeated, if necessary, until no turbidity is produced on adding oxalate. When a test is secured in which no lime is indicated, the second portion of the filtrate is tried for excess of soda ash, by adding a few drops of calcium chloride solution. If no turbidity is produced, the required quantity has been found, and the number of cubic centimetres of soda ash solution multiplied by 0.25 and by the number of tons of solution in the tanks gives the amount of ash in pounds to be added to the charge. Should the addition of calcium chloride, mentioned above, indicate that there is an excess of soda present, the original test may be repeated, using 0.5 c.c. less of the standard soda solution.

A slight excess of soda ash seems to be unimportant, but it is essential that no lime should be indicated.

It usually takes from 10 to 15 minutes to ascertain the amount of ash needed for a charge, and when this has been done the required quantity is placed in a screened drum hanging under the inflow pipe, and the pump and agitator started. By the time the tank is filled to the

*Patented on April 20, 1915.

required tonnage mark the reaction is complete and the charge is allowed to settle, the clear solution being then decanted to a sand-filter clarifier, whence it passes to the precipitation house. The turbid remainder is afterward stirred and run through a valve in the bottom into a smaller tank below fitted with a filter-bottom connected to a vacuum-pump; here the carbonate of lime settles and allows of a further decantation of clear solution to the sand-filter. The result of several days' operations is allowed to accumulate in this filter-tank, and finally the vacuum is turned on and the precipitated lime filtered to a firm cake. After a water-wash, to remove pregnant solution, the deposit is shoveled into empty cyanide tins and allowed to dry in the air for a few days, and then charged back into the lime-kiln to be re-burnt and used over again.

We have now followed the solution to the stage where

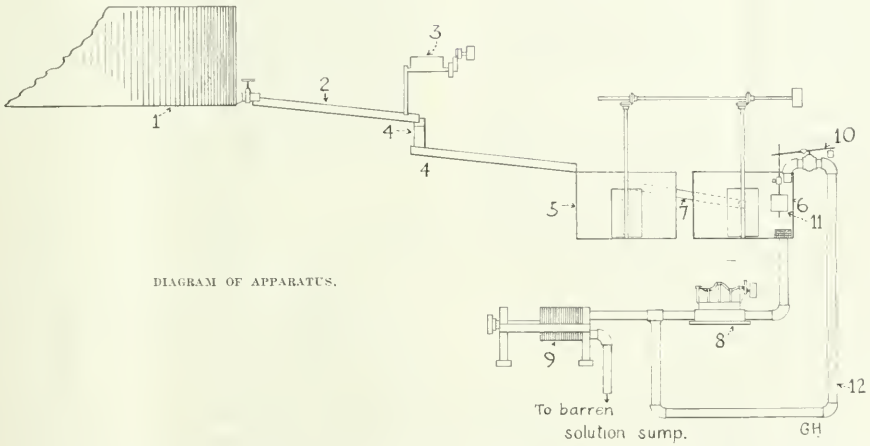


DIAGRAM OF APPARATUS.

it is ready for aluminum precipitation, and from this point onward its progress conforms with the method in use at Nipissing, but for the sake of those who have not read Hamilton's original article on the subject we give herewith a short sketch of the subsequent treatment.

The solution after leaving the clarifying filter passes down through a covered launder to the precipitation tanks. In this launder is added the aluminum dust, through a worm-feeder whose speed is adjusted by means of a pair of cone-pulleys. When it nears the precipitation tanks the continuity of the launder is broken twice, allowing the solution a clear drop of 6 inches each time, to assist in wetting the dust.

Referring to the diagram, (1) is the clarifying filter, (2) the launder, (3) the aluminum-dust feeder, (4) interruptions in the flow of solution, (5) and (6) the precipitation tanks. These latter are 6 ft. in diameter and 4 ft. deep, and are fitted with mechanical stirring-gear driven by the bevel-wheels and horizontal shaft above. To the vertical shafts are bolted boards 10 in. wide and 1 in. thick, extending from the bottom to within 12 in. of the top of the tank, and these shafts make 60 r.p.m. (7) is a 6-in. pipe connecting the two tanks; it extends almost to the bottom of (5), and after passing through the side near the top it slopes down somewhat and discharges into (6). It will be seen from this that the solution in tank (5) is maintained at a constant level, while the level of that in (6), though normally constant, can be varied at will, by raising or lowering the float (11) on the rod operating the automatic cut-off valve (10). (8) is a triplex 7x7-in. plunger pump running at 29 r.p.m. and drawing through a 5-in. pipe from tank (6), discharging into the filter-press (9). (12) is a 2½-in. by-pass line in the delivery of the pump, and its discharge is regulated by the automatic float-valve (10). Should the supply of solution from the clarifier be slackened off the level of solution in (6) would tend to fall, thus opening valve (10) and allowing the surplus solution passing the pump to return to the tank, in this way maintaining a constant level. The importance of this lies in the necessity of keeping the pump-suction water-sealed and preventing the entry of air. The operation of precipitation being a reducing one, the presence of air tends to retard it; moreover the silver precipitate formed by aluminum dust is so sensitive to re-solution influences that air in juxtaposition with cyanide solution will often cause metal to re-dissolve in the filter-press itself.

An appreciable period of time is needed to obtain complete precipitation by aluminum dust, and we usually allow from 15 to 20 minutes. A considerable variation in the length of time available may be obtained with this appliance by raising or lowering the level of solution in tank (6), which is effected, as already pointed out, by adjusting the height of the float (10) on the vertical rod.

There is also on the pump-delivery a pressure-gauge, and a relief-valve (not shown in the diagram) set at 80 lb., and discharging back into tank (6).

The filter-presses, of which there are three, are of the ordinary square-frame type used for cleaning-up. They are usually all in use at one time, but are cleaned-up one by one while the flow through the other two is temporarily reduced. In engaging an empty press the inlet-valve is partly closed so as to distribute the stream

of emulsion evenly between the three. The total filtering area available is 627 sq. ft. and this suffices for about 600 tons of solution daily.

The effluent from the presses unites in an iron drum, from which it flows to the barren sump. At this drum is kept a bottle of sodium sulphide solution, and when the shift-man makes his round every hour or so he takes a sample of the effluent and tests it for silver by adding a few drops of the sulphide. Should it show any trace of silver, and he finds on examination that the feeder is working satisfactorily, he slightly increases the flow of aluminum dust.

If a press is left idle for a few hours, or has just been cleaned-up, the effluent will always carry some re-dissolved silver, and to prevent this from salting the barren sump it is diverted to the pregnant sump for 5 to 10 minutes, or as long as may be necessary.

The precipitate obtained by this process is bulky and porous; it has a rich brown color, and melts readily with a minimum of flux. On an average it contains about 85% of precious metals, and when melted yields bullion 980 fine.

Results. During the period covered by the following data the cyanide used was sodium, 130%, costing 21c. per pound laid down at the mine, the cost of zinc was 7.2c. per pound, of aluminum dust 26c., and of soda-ash 2.4c. The aluminum precipitation figures represent averages over three consecutive months, during which the total quantity of ore crushed and cyanided was 28,100 tons. For comparison in zinc precipitation, three recent consecutive months have been taken, the total tonnage being practically the same.

Zinc

(Tons treated, 28,200)

	Total, lb.	Per ton, lb.	Total cost.	Cost per ton.
Cyanide	62,400	2.21	$13,104	$0.464
Zinc	29,816	1.05	2,146	0.076
Total	....	...	$15,250	$0.540

Aluminum

(Tons treated, 28,100)

	Total, lb.	Per ton, lb.	Total cost.	Cost per ton.
Cyanide	38,068	1.35	$7,994	$0.284
Aluminum	7,700	0.27	2,002	0.071
Soda-ash	43,013	1.53	1,032	0.036
Total	....	...	$11,028	$0.391

Thus, although the cost of aluminum and soda was 3c. more than the cost of zinc, yet the aluminum showed a saving of $4222, or 15c. per ton.

The bullion precipitated during the two periods was for the zinc process 134,628 troy ounces of fine gold and silver, and for the aluminum 173,660 oz. During the latter period the grade of ore was somewhat higher, and also the percentage of extraction, which accounts for the greater quantity of bullion recovered.

It is worthy of note that the actual difference in cyanide consumption of 0.86 lb. per ton in favor of aluminum is considerably more than that theoretically demanded by the quantity of silver dissolved. With a head value of 7 oz. and an extraction of 87% we should have 6.09 oz. per ton of ore going into solution, and since 1 oz. of silver combines with an amount of cyanogen equivalent to 0.06 lb. sodium cyanide, the amount of cyanide to be recovered from this source would be only 0.36 lb. per ton of ore.

There is a small quantity of copper dissolved, and at first sight it might seem as if the unaccounted increase in cyanide might be derived from the copper-cyanogen compound, but we have found, both here and at Nipissing, that copper is very difficultly precipitated by aluminum dust, and that under normal conditions hardly any is thrown down. As an illustration of this we may quote the following, which is one of the preliminary experiments made here before the introduction of the process. In this experiment 80 lb. of average battery ore was ground to a slime and agitated with freshly-prepared cyanide solution. After treatment this solution was precipitated with aluminum dust and used over again for another extraction test on similar ore. This was repeated four times, and each time, before precipitation, a portion of the solution was tested for sulphocyanate, ferrocyanide, and copper.

	1st time, %	2nd, %	3rd, %	4th, %
KCyS	0.023	0.05	0.08	0.113
K_4FeCy_6	trace	0.02	0.06	0.06
Cu	trace	0.006	0.009	0.014

The copper is here shown as gradually building up in strength each time the solution was re-used, indicating that precipitation, if any, was very slight. In the light of the recent working figures it is a matter for regret that copper determinations were not made both before and after precipitation, but this will doubtless be done on the working solutions in the near future.

Another possible but improbable theory is that the additional cyanide might be derived from the decomposition of sulphocyanate. We say "improbable" because in laboratory tests we have failed to break up KCyS in weak solutions (0.05 to 0.15% KCyS), though Clennell in a private communication states that by agitating with aluminum dust a concentrated solution made strongly alkaline with caustic soda he has succeeded in forming sodium sulphide, indicating a decomposition of sulphocyanate, but without any appreciable formation of free cyanide.

So far as we have gone at present, therefore, the source of the additional saving in cyanide is undetermined.

A point of interest in connection with this process is that, in the act of precipitation, there is usually a tendency to form soluble sulphide, probably by reason of the decomposition of thiosulphates. This tendency is not strongly marked at Divisadero, and, while traces of sulphide may often be found by testing the effluent of the press with a lead salt, they are never apparent in the barren sump, doubtless having been oxidized by contact with air during the passage of the solution thither. At the Nipissing soluble sulphide was found in considerable

amount, not only in the precipitating-press effluent, but also in the barren sump. To counteract this a drip of lead acetate into the stream was tried for a time, but as the presence of lead in solution was found to be detrimental to the extraction of the silver from the ore, this was soon discontinued, and, instead, an air-lift was placed in the barren sump to render the sulphide harmless by oxidation. This it accomplished rapidly, and no bad effects were ever noticed in the extraction treatment as a result of the formation of sulphide in precipitation. At Divisadero the question of soluble sulphide is ignored and no special preventive measures are taken. A small quantity of litharge and lead acetate is used during extraction, but this was proved advantageous when zinc was the precipitant and it has not been found necessary to increase the amount since the adoption of aluminum.

Conclusion. From the results given it will be apparent that there is no question of the saving in cyanide effected by aluminum precipitation, and that if there is any adsorption of the salt by precipitated alumina it is a negligible quantity as compared with the amount liberated for future use. Although at the prices of reagents current before the War the cost of aluminum precipitation is slightly higher than that of zinc, yet the introduction of the process here has been amply justified by results, and Mr. Charles Butters is to be congratulated for having allowed the experiment to be continued, in spite of the rather discouraging appearance of the process during the first two or three months, due to the difficulties and setbacks almost always encountered during the installation and development of new methods.

The Mnemonic system of filing papers employs twenty-three letters of the alphabet, thus having an advantage over the Dewey system, which employs decimals. The aim of the mnemonic system is to make each letter the initial of the term symbolized, hence it can be more easily remembered than an arbitrarily chosen number. In classifying the correspondence of a telephone company, for example, the divisions would be: C, Construction; E, Equipment; F, Finance and accounts; G, General; P, Operation; R, Rates; X, Executive. Construction will be subdivided thus: CC, Circuits, loops, phantoms, etc.; CK, Cables; CL, Pole-lines; CN, Conduits; CP, Poles, wires, etc.; CR, Real estate; CV, Private lines. Real estate may be classed under: CRC, Construction of new buildings; CRM, Maintenance of real estate; CRP, Purchase of property. Construction of new buildings will require: CRCC, Contracts; CRCN, Interior appointments; CRCP, Plans and specifications. Interior appointments need: CRCNF, Furnishing; CRCNH, Heating-plant; CRCNL, Lighting. Classification of lighting in detail: CRCNLE, Electric wiring; CRCNLG, Gas fixtures; CRCNLL, Oil; several kinds of oil will be shown by: CRCNL1L, CRCNL2L.

Alunite. Probably the most remarkable deposit in the world is a low bluff ridge, composed entirely of this material in the county of Gloucester, New South Wales. In 1912 the exports were 3425 tons valued at $68,500.

Crushing at the Tonopah-Belmont Mill

The crusher-plant has a capacity of about 100 tons per hour, and is operated only one 8-hr. shift per day. It is driven by one 100-hp. motor on crushers and trommel, one 20-hp. on waste-conveyor, one 7.5-hp. on grizzles and undersize-belt, one 20-hp. on inclined-belt, and one 15-hp. on horizontal battery-bin belt and automatic-tripper, a total of 162.5 hp. The actual power consumption, under full crushing load, is 80 horse-power.

Concaves for the No. 4 short-head crushers weigh 677 lb., cost $88, and last two years, crushing about 75,000 tons. These concaves are used about six months, are then set out, re-babbitted, and used for six months longer, when they are turned end for end and give another 12 months' service. The No. 4 mantle weighs 536 lb., costs $132, and has a life of two years, crushing about 75,000 tons.

Concaves for the No. 7½K crusher last about one year and crush about 150,000 tons. They weigh 1120 lb. and cost $202. The No. 7½ mantle weighs 1994 lb., costs $353, and lasts 18 months, crushing about 225,000 tons.

The manganese-steel trommel-screen weighs 3776 lb., costs $572, and lasts two years, handling 300,000 tons.

The consumption of wearing parts in the crusher-plant is 0.0325 lb. per ton of ore, at a cost of $0.00555.—A. H. Jones in Bulletin 104 of the A. I. M. E.

Waste in Mining

The losses sustained in other countries from lack of care and thought in this respect are enormous. Dr. James Douglas estimates, for instance, to take only one example, that at the Rio Tinto mines in Spain in a period of some 30 years, through the unskilful treatment of the ore, about 7,000,000 tons of sulphur, valued at not less than $70,000,000, was wasted, while with modern improvements in the method of handling the ore, about 1,000,000 tons of sulphur are annually saved to the world which would otherwise have been burned and served simply to pollute the atmosphere. He also points out that only about 60% of the hundreds of millions of dollars yielded by the Comstock lode was extracted at the time, and at first the rich tailing was not even collected, such was the haste of the miners to deplete that stupendous deposit which should have made Nevada prosperous for generations instead of whirling the whole country into a mad dance of reckless speculation.

The primary cause of a large part of this waste is over-capitalization, which involves a large output at any expense, if the value of the shares is to be raised and their price maintained. Over-capitalization generally demands over-production, which in its turn almost invariably involves waste at some stage of the progress of the metal from the mine to the consumer.

Combustion may be defined as the chemical union of combustible matter with oxygen, the supporter of combustion.

Methods of Paying for Metal Contents of Ores

By CHARLES H. FULTON

*No metallurgical process recovers all the metal in the ore, hence payment for all the metal cannot be expected. A deduction is made from the metal-content to allow for loss in treatment.

LEAD may be determined in two ways: (1) By wet analysis, which gives the actual amount of lead in the ore; (2) by fire-assay, in which the lead content is determined by fusion in a crucible. Fire-assaying may be considered smelting on a small scale. Therefore the smelter buys lead in ores on the basis of the fire-assay, as the results represent, in theory, the lead that he may expect to recover.

For ores that contain no appreciable proportions of easily reducible metals, like copper, antimony, and bismuth, or like zinc and arsenic, aside from the lead, the fire-assay gives results that are lower than those obtained by the wet analysis. The difference is usually about 0.5 to 0.9%; that is, an ore showing 35% lead by wet analysis gives 34.1 to 34.5% by fire-assay, or 700 lb. per ton by wet analysis and 682 to 690 lb. by fire-assay. On ores containing appreciable proportions of the metals mentioned above, the fire-assay often gives higher results than the wet analysis, as some of the metals are reduced with the lead, but these fire-assay results, of course, are incorrect. It follows, therefore, that in buying 'pure' ores, or those not containing easily reducible metals other than lead, the smelter wants to buy on the basis of the fire-assay, but when buying 'impure' ores, or those containing other easily reducible metals, he wishes to buy on the basis of the wet analysis, with a deduction to cover the loss in smelting. On the other hand, the position of the miner is reversed. He desires to sell 'pure' ores on the basis of the wet analysis and 'impure' ores on the basis of the fire-assay.

In order to adjust these difficulties the following practice has been adopted: For pure lead ores, such as are produced in the Coeur d'Alene district, Idaho, the fire-assay is still used to determine the amount of lead, although both mining and smelting companies check the results by wet analysis. In other instances, as in Utah, it is customary to make a fire-assay and then determine the lead in the fire-assay button by wet analysis and call the result the amount of lead in the ore. In still other instances a wet analysis is made for lead, and a deduction of 1, 1.3, or 1.5% is made from the result to give the 'dry assay', the equivalent of the fire-assay. For example, if an ore gives a content of 20% lead by wet analysis, the dry content will be 19 to 18.7 or 18.5% dependent on the deduction agreed upon. In short, an effort is made to determine the percentage of lead in the ore that is recoverable by the smelting operation.

The question arises whether the results obtained by fire-assay correspond to the yield in smelting. The losses in lead smelting, exclusive of those connected with refining, may be stated as ranging from about 4.5 to 17% of the lead smelted, as determined by wet analysis. Such losses include the loss incurred in roasting a fair proportion (35%) of the charge. The low figure applies to the smelting of a furnace-charge high in lead, that is, a charge, considered as a whole, that contains about 30 to 35% lead, whereas the high figure applies to furnace-charges low in lead, say somewhat less than 10%, or to charges that contain a large percentage of roasted material. The loss in normal smelting, or with 10 to 15% lead on the charge, is 8 to 11%. Therefore, an ore containing 35%, or 700 lb., of lead per ton, or 682 lb. by fire-assay, will yield in the normal furnace charge 89% of its contents, or 623 lb., a loss of 77 lb., or 59 lb. more than the fire-assay indicates. In the same way a deduction of 1.5% from the lead content of this grade of ore does not cover the smelting loss. On the other hand, if an ore contains 10% lead by wet analysis, or 200 lb. per ton, and the smelter pays for 10 – 1.5%, or 8.5%, or 170 lb. per ton, and he again recovers 89%, or 178 lb., it is obvious that his deduction more than covers his smelting loss.

It is therefore generally true that the fire-assay basis or its equivalent, the dry-analysis basis (wet analysis less 1.5%), does not cover smelting losses for medium or high-grade ores, but somewhat more than covers smelting losses for low-grade ores, provided a furnace-charge containing not less than 12% lead can be made.

In order to safeguard himself, the smelter makes an additional deduction to cover loss in smelting. The procedure in Utah is as follows: The smelter pays for 90% of the lead content, either determined by fire-assay or put on the dry-analysis basis; that is, lead determined by wet analysis less 1.5%. When this additional deduction is made, the total deduction more than covers any loss, as per the following example: In an ore containing 35% or 700 lb. of lead by wet analysis, or 682 lb. by fire-assay, payment will be made for 90% of 682 lb., or 613.81 lb. The loss in smelting this ore under the conditions already described will be 77 lb., or 9.2 lb. less than the deduction made. Again, as the grade of the ore decreases, the deductions made will become considerably greater than the actual losses.

In Colorado no special additional deduction is made, but its equivalent is obtained by paying less for the lead.

COPPER CONTENT is determined by wet analysis, either electrolytically or else volumetrically by iodide or cya-

*Abstract from 'The Buying and Selling of Ores and Metallurgical Products,' Technical Paper No. 83, U. S. Bureau of Mines.

nide method. In Michigan the fire-assay is still used for metallic copper concentrate or 'mineral.' The smelter desires to obtain a figure representing the 'yield,' as this theoretically corresponds to what he recovers in smelting and is all that he can be expected to pay for. Hence the copper paid for is the 'dry' copper, that is, the actual amount of copper as determined by the wet assay less a standard deduction for changing to dry basis. This deduction is usually either 1, 1.33, or 1.5%, but occasionally may be as low as 0.75%. Naturally, therefore, when the copper content of an ore is less than 1.5 or 1%, it is not paid for. When a contract specifies that the copper content on the basis of a dry analysis is equivalent to "wet less 1.5%," it means that if an ore contains actually 12.5%, or 250 lb. per ton, payment will be made for only 220 lb., the difference, or 30 lb., representing loss in smelting.

Usually the placing of the copper content on the dry basis fully covers any smelting losses sustained. According to the grade of the ores smelted, copper losses vary from 5 to 15%, the higher figure applying to ores of lower grade.

Gold and Silver. The deduction for loss in extracting gold and silver is made somewhat differently. Often the deduction for smelting loss is 5% of the gold content and 5 to 10% of the silver content. Thus a contract may read: "Gold will be paid for at 95% of the assay at $20 per ounce. Silver will be paid for at 95% of the assay at New York quotations." In other instances, in place of making a percentage deduction from the assay to cover loss, the price paid will be decreased to $19 per oz. for gold. Gold in an ore is usually not paid for if less than 0.03 oz. per ton is present, and silver if less than 1 oz. per ton. This is due to the fact that in a smelting mixture giving a certain type of slag the slag will retain a fixed amount of metal. In smelting low-grade ores the proportion of loss is much greater than in smelting high-grade ores.

Cost of Freight and Refining. So far the charges for smelting the ore and the deductions for loss of metal have been considered. There still remains to be added the cost of freight to the refining centre and of refining the metal in the crude product, so that it may be placed on the market. This charge is imposed by paying for the metal-content a lesser price per pound or unit than the quotation for refined metal. Thus copper in ore may be paid for at the New York quotation on electrolytic copper, on the date of assay, less 3 cents per pound, this 3 cents covering the refining, freight, and selling charge. Sometimes copper is paid for on the unit basis, for instance, $2.80 per unit of 20 lb. With refined copper at 17c., this is equivalent to a deduction of 3c. per pound.

This method, however, is not common for copper ores because it leaves out of consideration the fluctuations in copper prices and places a fixed value on the copper content of the ore during the terms of the contract. Lead in ore is more frequently bought on the unit basis, the price per unit varying with the sales price of the metal at New York. The price paid per unit of lead is always less than the value of 20 lb. of lead at prevailing lead prices. Thus lead may be paid for at 50c. per unit when the price of lead in the market is 4c. per pound. This rate means a deduction of 30c. per unit or 1.5c. per pound to cover refining and freight charges. When copper and lead in ores are bought on a unit basis, payment is usually made on a sliding scale, higher prices being paid per unit on ores that are high in metallic content.

Payment for lead in ores, after the percentage has been determined by fire-assay, or by wet analysis less either 1 or 1.3 or 1.5%, is made according to one of three methods:

1. By the unit and at quotation, a system used chiefly in Colorado.

2. For 90% of the lead content at the sales price, with a deduction per pound, a system used chiefly in Utah.

3. For 90% of the lead content at 90 or 95% of the sales price, a system used for Idaho ores.

Following are examples of payment by the unit-and-quotation system. The smelter pays for 'wet' lead, less 1.5%, as follows:

Lead content, dry basis, %	Price per unit.	Lead content, dry basis, %	Price per unit.
5 to 10	$0.35	25 to 30	$0.49
10 to 15	0.40	30 to 35	0.51
15 to 20	0.45	Over 35	0.51
20 to 25	0.47		

Unit equals 1%, or 20 lb., per ton.

The price per unit is based on what is called a 'quotation' of $4 per 100 lb. of lead. For every rise or fall of 5c. in the quotation 1% is added or deducted from the price per unit. The quotation is not the sales price in New York, but is determined as follows: If the sales price in New York is $4 per 100 lb., the quotation taken is 90% of this price, or $3.60. If the sales price is more than $4 and not above $4.50, the quotation is obtained by taking $3.60 and adding to it one-half of the excess of the sales price over $4. If the sales price is more than $4.50, the quotation is obtained by taking $3.60 and adding to it half the excess of the sales price between $4 and $4.50 and all of the excess above $4.50.

As a concrete example of payment by the unit-and-quotation system, suppose the sales price in New York is $4.30 per 100 lb. The quotation will then be determined as follows: $3.60 + ½ ($4.30 − $4.00) = 15c., or $3.75.

In the case of an ore containing 35% lead, for which, according to the table, 51c. is paid per unit on the basis of a $4 quotation, the price will become 51c., less as many cents as there are 5-cent units in the difference between $4 and the new quotation of $3.75. The difference is 25c.; therefore a deduction of 5c. per unit is made from 51c., and the actual price per unit paid is 46 cents.

By way of further example, suppose the sales price in New York is $5 per 100 pounds. The quotation will then be as follows: $3.60 + ½ ($4.50 − $4.00) + ($5.00 − $4.50), or $4.35. For a 35% ore for which 51c. per unit is paid on a quotation of $4, the price per unit will become 51c. + ⅕ ($4.35 − $4.00), or 58 cents.

Question. If a miner has a ton of lead ore that contains 36.5% lead by wet analysis, and the sales price of

lead in New York is $4.30 per 100 lb., what would be the value of this lead in New York, and what does he receive for it from the smelter?

Answer. The ore contains 730 lb. lead, which, at $4.30 per 100 lb., amounts to $31.39. The miner is paid for 35% lead at 46c. per unit, or $2.30 per 100 lb., a total of $16.10. The difference is $15.29. Of course, the miner is in no sense entitled to the full value of his lead, for certain losses and charges must be deducted; however, it is not just to make too great a deduction.

Under the method of payment on the basis of 90% of the lead content at the sales price, with a deduction per pound, the lead content is determined by the fire-assay, or by the wet method less the deduction of 1 or 1.3 or 1.5%. Ninety per cent of the lead thus determined is paid for if more than 5% lead be present; if the proportion be less, it is not paid for. The lead is paid for at the New York sales price, less a deduction of 1.5% per pound, if the lead content of the ore is less than 25%; a deduction of 1.25c. per pound is made if the lead content is more than 25%.

Question. If a miner has a ton of lead ore that contains 36.5% lead by wet analysis and the sales price of lead in New York is $4.30 per 100 lb., what would be the New York value of this lead to the miner and what does he receive for it from the smelter?

Answer. The ore contains 730 lb. lead, which, at $4.30 per 100 lb., amounts to $31.39. He is paid for 90% of 35% (36.5 less 1.5%) of lead, or 630 lb., at the rate of 4.3c., less 1.25c., or 3.05c. per lb., which amounts to $19.21. The difference is $12.18.

Under the method of payment for 90% of the lead content at 90 or 95% of the sales price, the lead content is determined by the fire-assay or by the wet method less the deduction of 1 or 1.3 or 1.5%. Ninety per cent of the lead thus determined is paid for at 90 or 95% of the sales price in New York as may be agreed upon. Lead in an ore, if less than 5%, is not paid for.

Question. If a miner has a ton of lead ore that contains 36.5% lead by wet analysis, and the sales price of lead in New York is $4.30 per 100 lb., what would be the value of this lead in New York and what does he receive for it from the smelter?

Answer. The ore contains 730 lb. of lead, which, at $4.30 per 100 lb., amounts to $31.39. He is paid for 90% of 35% (36.5 less 1.5%) of lead, or 630 lb., at 90% of $4.30, or at the rate of $3.87 per 100 lb. This amounts to $24.38. The difference is $7.01.

A comparison of the rates under the three methods for the three examples presented is given below:

Method of payment	Quantity of ore tons	Lead content %	Gross ore value	Paid to miner	Value to smelter
By the unit, and at quotation	1	36.5	$31.39	$16.10	$15.29
On basis of 90% of lead content at sales price, with deduction per pound.....	1	36.5	31.39	19.21	12.18
On basis of 90% of lead content, at 90 to 95% of sales price	1	36.5	31.39	24.38	7.01

Evidently the first system gives the least return on the lead. In this connection the reader should note, however, that the contract as a whole must be considered. For instance, under the first system, treatment charges are much lower than under the third system, so that the net outcome to the miner may be about the same on the same kind of ore under any of the systems.

In certain instances the smelter absorbs part of the rise in price of lead when the sales price goes above a certain figure. Thus, if the sales price in New York is $4 or less, the smelter pays at the rate of 90% of the sales price. But if the sales price rises to a figure between $4 and $4.50, the smelter will not pay at the rate of 90%, but will pay for only 90% of $4 plus one-half of the excess of the sales price over $4. If the price is above $4.50, it will pay for 90% of $4 plus one-half of the excess between $4 and $4.50 and all the excess above $4.50. As an example, if the sales price in New York is $4.80, the miner, on the basis of 90%, should receive $4.32. Actually he receives on the modified basis 90% of $4, or $3.60, plus ½ ($4.50 – $4) plus ($4.80 – $4.50), or $4.15 per 100 lb. The difference of 17c. per 100 lb. is absorbed by the smelter.

A feature of most schedules is that they do not provide for payment for a lead content of less than 5%. In some instances a lead content of less than 5% is paid for at the same rate as the bonus is granted on iron, namely, at 15c. per unit, as against the rate of about 40c. per unit usually paid for lead when present in low percentages. Another feature is that the price per unit paid for the lead in ores of low lead-content is less than that for ores of high lead-content. In the same way under the second system the deduction per pound is greater for ores of low lead-content than for ores of high lead-content. This difference is perhaps justifiable from the smelters' standpoint in that the losses are comparatively greater in smelting low-grade ores than in smelting high-grade ores.

PAYMENT FOR COPPER IN ORES, the percentage being determined by wet analysis, less 1, 1.3, or 1.5%, as the case may be, is made on the basis of the New York price of refined copper less a deduction to cover the cost of refining and freight of the metal to the market. The quotations in New York are made on three brands of copper as follows: (*a*) Electrolytic copper in the form of ingots or wire-bars; (*b*) electrolytic copper in the form of cathodes, that is, the electrolytically deposited copper in its original form previous to melting, and (*c*) casting copper, or copper not electrolytically refined and only reasonably pure. Cathodes are usually quoted at about 0.1c. less, and casting copper at 0.2c. less than wire-bars. The amount of the deduction from the market-price is given in the accompanying table.

It will be noted that the deduction on lead ores containing copper is greater than on 'straight' copper ores, the reasons being as follows: When copper is present in an ore that goes to make part of a mixture smelted in the lead blast-furnace, the aim of the metallurgist is to recover this copper in the form of a matte. The liquid

Kind of ore.	Dry copper content of ore, %	Deduction per pound.
Lead ore containing copper	1.5 to 5	6c. off casting-copper quotation.
	5 to 10	5c. " " " "
	More than 10	4c. " " " "
Copper ores	1.5 to 5	5c. " electrolytic-copper "
	5 to 10	4½c. " " " "
	10 to 20	4c. " " " "
	20 to 30	3½c. " " " "
	More than 30	3c. " " " "

Dry copper content represents content as determined by wet analysis less ½%.

products that flow from the furnace are (1) lead, which contains alloyed with it gold and silver and a varying proportion of such impurities as bismuth, arsenic, antimony, small amounts of sulphur, and some copper; (2) matte, a sulphide of iron, copper, and lead containing some silver and a little gold; (3) slag, which is the molten refuse of the furnace, composed of the gangue, or worthless material of the ore. This slag always carries away with it a certain proportion of the valuable metals—lead, copper, gold, and silver. These three products have decidedly different specific gravities, so that they can be readily separated, the lead, or heaviest, being separated in the furnace, whereas the slag, or lightest, is sparated from the matte in a settling chamber directly in front of the furnace. The slag goes to waste and the matte is saved.

The formation of matte is due to the presence of sulphur in the charge, and the amount produced is in direct proportion to the amount of sulphur present. If no sulphur were present, no matte would be formed, and any copper in the furnace-charge would enter the lead. This result would be undesirable, because the refining of lead containing considerable copper is costly and wasteful. If too much sulphur be present too much matte will be formed, in turn taking up a large quantity of lead, and making the refining of this product costly and wasteful. The real object, therefore, in forming matte is to throw the greater part of the copper present in the furnace charge into a separate product from which it can be more easily recovered.

The matte produced in the lead-furnace is different from the matte produced in copper-smelting in that it contains some lead, as well as copper. Its treatment for the recovery of the metals in it is consequently more costly than that of a copper-matte, and this fact is reflected in the deductions made from the price of copper in lead ores as against those made from the price of copper in copper ores. Copper in lead ores is usually paid for at market price less 4 to 5c. per pound, whereas copper in copper ores is paid for at market price less 2 to 3c. per pound.

Penalties are added to the smelting-rate on account of the presence in the ore of certain undesirable substances. The matter of penalty for excess silica has been discussed rather fully. The reason for the payment of a bonus for iron has been mentioned. Substances, the presence of which is commonly penalized, are zinc, sulphur (in lead smelting), arsenic (sometimes loosely called speiss), and antimony.

The zinc in the ore is not recovered in the process of lead or copper smelting, but passes partly to the slag and partly into the fume and flue-dust. The slag may contain as much as 8 or 10% zinc without much detriment, but when the proportion is greater, the slag becomes viscid, decreasing the furnace-capacity and increasing slag-losses. In the fume, zinc causes trouble by incrustations in the furnace and by increasing losses by volatilization. Hence a limit of 10% zinc is usually placed on ores, and every unit (20 lb.) per ton above this amount is penalized at the rate of 30 to 50c., the penalty charge thus obtained being added to the smelting-rate. This penalty is so heavy that in dressing ores there is a decided incentive to separate the zinc minerals into a distinct product whenever possible, thus avoiding the penalty on zinc in the lead and copper product, and at the same time obtaining a saleable zinc product that may be sold to the zinc smelter.

A sulphur content greater than 3% is penalized in lead smelting. It is customary to impose a penalty of 20c. on each unit of sulphur in excess of 3. In lead blast-furnace smelting, only a small percentage of sulphur is permissible in the charge, and ores high in sulphur must first be roasted. The roasting entails considerable expense, which is met by the imposition of a penalty on the sulphur content, this penalty being added to the smelting charge. In copper smelting, sulphur is desirable rather than otherwise and is not penalized.

Arsenic is commonly penalized in lead smelting and, occasionally, in copper smelting. Penalty is usually imposed on an arsenic content greater than 1 unit. The presence of arsenic in the lead blast-furnace charge causes the formation of an artificial arsenide of lead, iron, and copper, known as speiss, a most undesirable by-product and costly to treat for the recovery of the contained metals. Its undesirable qualities usually become apparent in the refinery. If arsenic be present in the furnace charge in small amounts, it will pass into the lead bullion, making this difficult to refine.

Antimony causes difficulties somewhat similar to those occasioned by arsenic, but is recovered in the refinery in the form of antimonial lead, which is a saleable product, so that a penalty is rarely imposed on antimony in lead-smelting operations.

The limits set for the occurrence of undesirable constituents vary much in schedules and contracts. Thus it is by no means standard that 3% represents the upper limit of sulphur content in lead ores, so as to be free from penalty. Occasionally penalty is imposed on a sulphur content greater than 1%, and again it may not be imposed until 6% is reached. The same remarks apply

to zinc and other substances subject to penalty. Neither are the prices charged per unit uniform or standard. Limits and prices are usually subject to agreement between the ore seller and the smelter.

Margins. It is apparent from the foregoing discussion that the deductions made for the smelter from the gross value of the ore is much more that the smelting charge alone, for it consists of that charge, plus the deductions resulting from the lesser price paid for the metals, the lesser amount of metal paid for, and the penalties. The smelter also deducts the freight-rate on the ore and makes settlement for this with the railroad company.

In discussions of the smelter business, the term 'margin' is often used; it may be briefly defined as the difference between the actual value of the ore to the smelter and the amount paid to the shipper. What is paid the shipper is the difference between certain credits and debits, the credits consisting of the sum due on metals at the agreed amounts and prices as per contract, and the bonus allowance on iron or lime; the debits consist of the freight and treatment charges and the penalties imposed. The difference is the net amount paid the shipper.

The gross value of the ore to the smelting plant, if this be of the ordinary type, not refining its own product, is the total metal content (100%) at a certain price per metal which is arrived at by taking the market quotation for the metal and subtracting from this a sum to cover the refining charge and the freight of the metal to the market. For example, if copper is quoted at 16.3c. per pound at New York, a Western smelting plant will figure copper to be worth 14.7c. at the plant, the difference, 1.6c., being allowed to cover refining and freight to market. In the same way, with lead quoted at 4.35c. at New York, a certain smelting plant will figure lead to be worth 3.34c. to itself at the plant, the difference of 1.01c. covering refining and freight. Similar allowance is made for the cost of recovering and refining silver and gold.

The gross value of the ore, determined as outlined above, less the net amount paid the shipper, is the margin on the ore to the smelting plant. This margin is the amount that the smelter has to cover his cost and profit and loss. As he has charged himself with 100% recovery, the loss of metal in smelting will appear as a charge against the margin. In calculating the final outcome to the smelting plant it is again desirable to consider debits and credits, the margin plus the value of the iron and lime contents being the credit, whereas the metal loss placed at the smelter's value for the metals, the charges for the silica and sulphur contents of the ore, the base cost of smelting, the cost of converting copper, and the interest charge for holding the metal stock, are the debits. The difference between debits and credits is the profit or loss. The refining company will conduct its accounts in a similar manner.

Résumé. It is evident from the foregoing that smelting rates and schedules are of a complex nature, although the principles on which they are based are reasonably simple. It is frequently stated that these rates and charges are made wilfully complex by the buyer, in order to obscure the amount of the deductions made. This view may have been correct in some instances, but the main reason for the complexity of present rates and schedules is to be found in the fact that the details have been increased from time to time as the smelting industry grew, new processes were invented, and new types of ores were found. It certainly seems desirable that the rates and schedules should be simplified in order that they may be more comprehensible to shippers of ores, particularly the small shipper who often is not familiar with the intricacies of the business and hence is not in a position to know whether justice is done him.

There is little question but that the principles upon which the rates and schedules are founded are just enough. However, individual deductions and charges for smelting might not be so reasonable. At first sight it would seem that when lead is worth 4.7c. per pound, a deduction of over 60% in this value to cover smelting, refining, and freight is too much. Determination cannot be made superficially, but there is no question but that, per ton of metal recovered, the smelting of low-grade lead or copper ore is much more costly than that of high-grade ore.

Another point of contention relates to the deduction for silica and the bonus for iron when ore is purchased on the neutral schedule. Frequently the penalty for excess silica is 12c. and the bonus for iron is 10c. It is claimed that the penalty and the bonus should equal each other. This claim is perhaps reasonable in copper smelting, in which the unit of silica is about equivalent to a unit of iron, but in lead smelting two units of iron plus lime are needed to be equivalent to one unit of silica, so that it seems fair to make the penalty on silica higher than the bonus for iron. However, in many contracts at the present time the bonus and penalty figures are equal. It is customary for a shipper who controls a considerable ore-supply to enter into contract with the smelting company for the treatment of his ores. In instances of this kind, which are frequent, much better rates and schedules are often obtained than are specified in the so-called open schedules, which are published for the shipper of small isolated lots. Rates also vary, the variation being dependent on the demand for certain kinds of ore. Thus, at times the silicious or 'dry' ores are scarce and again ferruginous ores are scarce, so that rates vary with the supply.

Oleic acid, usually called 'Red Oil,' is a fatty substance that plays the part of oil in the flotation processes. It is an organic acid obtained as a by-product in tallow-candle manufacture. It is solid at the ordinary temperature, and when required for flotation is liquefied by warmth, in order that it may be spread through the pulp, as butter is melted to a thin liquid in order to cover pop-corn.

Excavation continues at Panama, the June output of earth, rock, and gravel being 1,120,029 cubic yards.

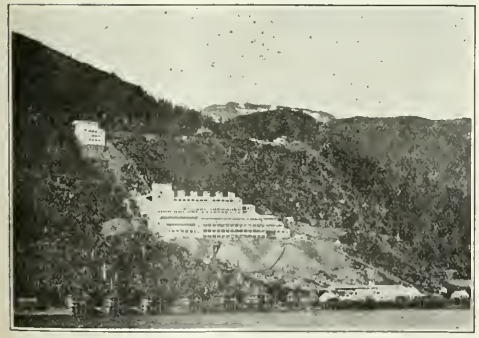
Perseverance Mine and Alaska Gastineau Mill

By ROBERT S. LEWIS

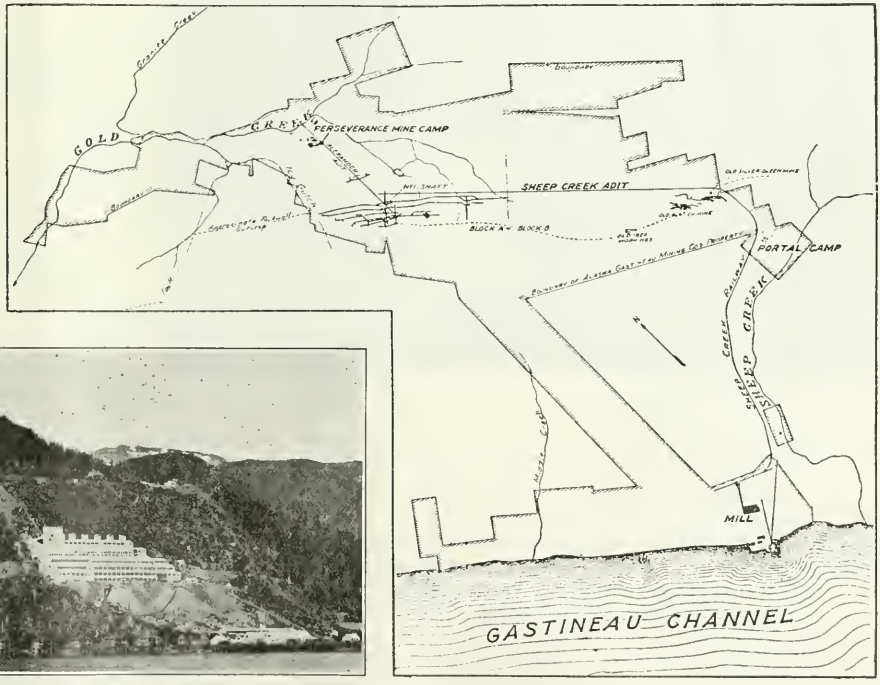
The mill of the Alaska Gastineau Mining Co. is at the town of Thane, 3½ miles down the Gastineau Channel from Juneau, where a large dock permits of landing supplies directly from steamships.

A railroad 17,000 ft. long connects the mill with the Perseverance mine. This road follows the northern side of Sheep creek for about 6000 ft. and then plunges into a 10,000-ft. tunnel that leads to the mine ore-bins in the very heart of the mountain. These bins are on the 1300-ft. level, the present bottom level of the mine, but prospecting has not yet been done to determine the lower limit of the ore, of which there is enough above this level to keep the mill running at full capacity for many years. The lode, which consists of slate, dips at approximately 70° and has a schist hanging wall and a greenstone footwall. Several gabbro dikes cut the lode. Stringers of quartz, varying in width from the thickness of a knife-blade to nearly two feet run irregularly through the lode and the dikes. The slate and gabbro carry small quantities of gold, but nearly all the free gold is found in the quartz stringers, together with pyrite, pyrrhotite, galena, and a little sphalerite. The stringers are richest in the gabbro, especially where sphalerite is present. Picked specimens show coarse specks of gold. Sorting cannot be done, consequently the entire lode is mined and sent to the mill. The lode varies in width from 50 to 200 ft., but the stringers of quartz often run out into the footwall, so that the limit of 'ore' must be determined by assay. A thin layer of slippery gouge keeps the lode quite free from the hanging wall. This fact is utilized in mining, as will be explained later.

A vertical shaft connects the 1300-ft. level with the top, or 500-ft. level, the shaft-house of reinforced concrete being built on the side of the mountain. This shaft is used only for hoisting men and supplies to the various levels. An air-driven hoisting-engine placed on the 1300-ft. level operates the two cages. The hoisting-ropes run up between the two compartments to the sheaves, which are set diagonally to the shaft in order to carry the ropes out to the centres of the compartments. Signals are given by the Anaconda system of flashing lights. In addition, a mine-telephone connects the levels with the out-



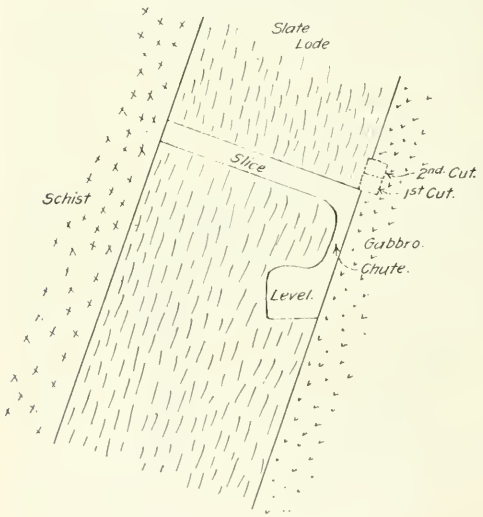
ALASKA GASTINEAU MILL, AT THANE.



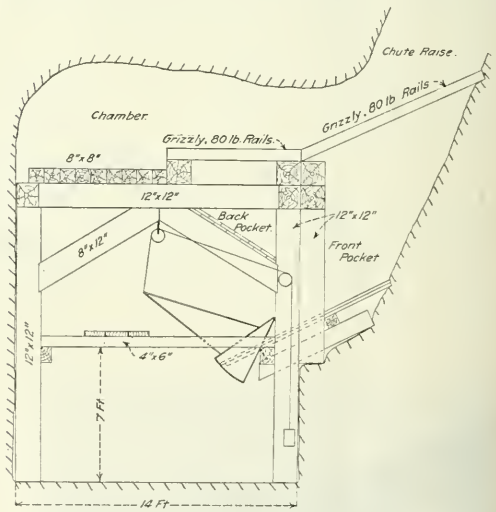
LOCALITY MAP OF ALASKA GASTINEAU PROPERTY.

side office. Since the engineer cannot see the shaft, a run-away and over-winding device has been found useful in preventing accidents. Several times, especially during the night-shift, it has kept the cages from being pulled into the sheaves.

From the different levels, which are 200 ft. apart, the ore is dropped through an ore-way to the 1300-ft., or main haulage, level. This ore-way is almost wholly in the foot-wall and parallels the vein. At the 900-ft. level a large timber bulkhead is used to break the fall of the ore that is dropped from the upper levels and thus prevent it from striking the bins at the bottom with destructive force. The bulkhead is hinged and is pulled out of the way when not required. In falling through the ore-way a marked sorting action takes place in the ore, so that when it is drawn from the bins the coarse pieces at the bottom come first and the fine comes last.



SKETCH OF CAVING METHOD.



BULLDOZING CHAMBER AND CHUTE.

Haulage to the mill is done by electric locomotives of the usual trolley type, but the interesting feature of the haulage in the levels is found in the use of storage-battery locomotives (6-ton Baldwin type.) Trains of nine 4-ton cars are hauled at any speed up to 16 miles per hour. An experience of over three years with this system of haulage has proved it most satisfactory. Costs are low, and the expensive and dangerous trolley-wire is eliminated. The locomotives are operated for 16 hours and are then charged for 8 hours.

In view of the large daily tonnage—over 12,000 tons—that is to be expected from this mine in the future, provision has been made for handling a much greater tonnage than is now being mined. (3300 tons per day was being mined at the time of my visit late in June.) The mine-cars are of the Granby type; this is an automatic side-dump car, operated by a projecting arm or lever which runs over a trip. After passing the trip, a car rights itself. The ore falls through a narrow opening into the ore-way. Thus the motor-man alone does both the dumping and the hauling. The cars pass over the dump at a speed of about three miles per hour. It is not likely that the haulage system will prove inadequate to any demands that may be made upon it.

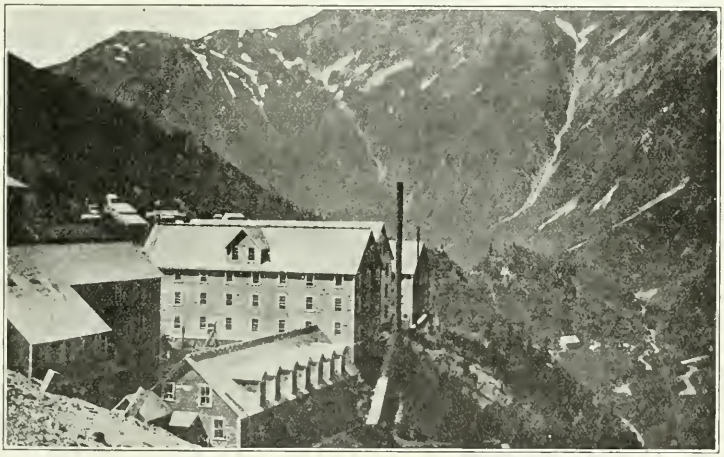
The stopes at full size are 400 ft. long with 40 ft. pillars between. A raise is carried through the middle of each pillar. Half of the raise is used as a man-way, the other half is a skip-way along which an air-hoist delivers drill-steel and other supplies from the level below. The stopes are started from the tops of chutes run along the foot-wall, although in wide stopes some chutes may be on the hanging-wall side of the vein. Two methods of stoping are used; shrinkage stoping and a special caving system. Shrinkage stoping is carried out in the gabbro, which is so hard that the back, far from requiring any support, must be drilled and blasted. The machines are set up on the broken ore, just enough of which is drawn out to afford working space for the miners. In the slate the caving system is best. This has been ascertained as the result of several years' experience with the vagaries of this particular material. From the tops of the chutes a slice is taken directly across the lode, and at right angles to the dip. (Though the lode is quite free from the hanging wall, it will not fall unless the cut should be made horizontally.) To start movement in the lode, a cut, well in the foot-wall, is next driven along the length of the stope. The cut is largely in the foot-wall to give the men a good roof under which to work. A slate roof is dangerous, it being almost impossible to test its firmness by sounding with a hammer or drill. Often no further work is necessary for some time, as the stope keeps slowly caving until a dome of equilibrium is established. Then a second cut will start the caving again.

One stope supplied ore for six months without a man working in it. In another stope four machines broke 26,000 tons in one month. In case the ore hangs or does not come down fast enough, a cut is made across the end of the stope along the side of the pillar. Faults in the lode cause no serious trouble from falls unless they are longitudinal faults, or faults of flat dip running along the length of the lode, when large blocks may come down. In one stope a block of ore 180 ft. long, 40 ft. wide, and 72 ft. thick came down in a solid mass. Nearly a month of drilling and blasting was required to get this ore into the chutes.

The prevent choking by large lumps, the chutes are protected by grizzlies, and safe places, called 'bulldozing chambers' are provided for breaking the large pieces. (See sketch.) The narrow neck protects the men working in the chamber from a dangerous rush of ore. All large pieces caught by the inclined grizzly are 'bulldozed' until they will pass through the horizontal grizzly into the back pocket below. This breaking of the ore before it reaches the chutes and oreways greatly lengthens the life of the ore-passes and makes it much easier to operate the bin-gates.

Water-Leyner piston machines are used for the heavy drilling in the stopes. Hammer-drills are employed in the raises, chutes, and for starting the stopes. Air is supplied at 100 lb. pressure. Dynamite of 30% is largely used, though 40% dynamite works to better advantage in the hard gabbro. In this gabbro 58 tons is broken per machine-shift as against 150 tons in medium-hard rock. The broken ore does not pack in the stope and runs freely whenever the gates are opened. Arc-gates are used throughout the mine. By the simple expedient of working from the bottom up, that is, the gates being pulled up to cut the stream of ore instead of being pushed down into it, they check the ore cleanly and almost instantly. The main loading-chutes on the 1300-ft. level have additional regulators in the form of the common rack-and-pinion gates. These are kept open at a suitable width, and serve to protect the arc-gates from the great weight of the ore in the bins. At this station four gates are used, one per car. In this way four 10-ton cars are loaded simultaneously, requiring only 8 spottings for the full train of 32 cars.

The very steep slope upon which the mill was built rendered it by no means an ideal millsite, a large amount of excavating in hard rock being required for the foundation. The bottom floor of the mill is 192 ft. above the Gastineau Channel, while the crushing plant is 493 ft. above the mill or 685 ft. above the water. Supplies are sent from the wharf directly to the mill over an inclined tramway, while a longer tramway carries material to a loading-station on the ore-railroad, from where it is sent either to the crushing plant or the mine. The rotary dump in the crushing plant handles four 10-ton cars at a time, dumping the ore upon an inclined grizzly having 8-in. openings. The grizzly is made of heavy I-beams, the upper flanges of which are protected from wear by manganese-steel shoes, which are cast in short sections to facilitate renewing. Air-operated finger-gates feed the oversize to two 36 by 42-in. Blake crushers set to 5 inches. From the crushers the ore passes over apron or caterpillar feeders, driven by changeable-speed gearing, to



THE MESS AND CLUB-HOUSE AT THE PERSEVERANCE MINE IN SILVER BOW BASIN, ALASKA.

stationary inclined screens made from ½-in. round iron and having 1½-in. square openings. The oversize, after being reduced in two No. 8 gyratories set to 2-in., unites with the undersize and drops into an ore-pocket directly beneath the crushing plant. This pocket is cut in solid rock and is 225 ft. in height, 110 ft. of which is the ore-pocket proper, being 30 by 50 ft. in cross-section. The remaining 115 ft. is a raise connecting the ore-pocket with the crushing plant. This unique ore-bin has a capacity of 10,000 tons. Arched steel plates between heavy I-beams form the bottom of the bin, and rest on reinforced concrete arches about 3 ft. thick. Between the arches are 8 variable-speed pulley-feeders, which supply ore to the 42-in. belt-conveyor. This conveyor, 608 ft. long, runs out through a tunnel to the coarse ore-bins in the mill. Operating at a speed of 315 ft. per minute, it has a capacity of from 300 to 600 tons per hour, depending upon the depth of loading. The entire framework of the conveyor is of steel, solidly anchored to the concrete floor of the tunnel. Ample space has been provided for a duplicate conveyor. From the bins the ore goes to stationary inclined screens having 1½-in. square open-

ings. The oversize is sent to 72 by 24-inch rolls set to $\frac{1}{8}$-inch and the undersize to 54 by 24-inch rolls set to $\frac{3}{8}$-inch. The rolls are run on choke-feed and crush dry. They are of unusually heavy design, having the large pulley in the form of a fly-wheel weighing 8000 lb. This construction requires an outboard bearing at the end of the roll-shaft. The bearings are water-cooled. Both large and small pulleys are on the same side of the rolls. The shells are 6-in. thick and are shrunk onto the roll-cores. Five-ton skips raise the product from the rolls 115 ft. to a series of 10-mesh impact-screens, the undersize going to the concentrating department and the oversize being returned to the 54-inch rolls. These skips represent a unique departure from the elevating machinery commonly employed in mills. Two work in balance, with automatic electric control. While it is being filled, the skip rests on a chair arranged to operate a trip when the desired weight of ore is in the skip. For smooth operation the hoisting cables must have any noticeable stretch taken up immediately, so as to maintain the skips in their proper relative positions. Each skip has an adjustable take-up for its cable. The flat cable, $\frac{5}{8}$ by $4\frac{1}{2}$-inch, is wound on a small reel, the shaft of which is the pin of the shackle connecting the cable to the skip. Stretch in the cable is taken up by a slight turning of the reel. Each of the four sections contains 15 impact screens, making a total of 60 for the mill, and there are two 54-inch rolls for every 12 impact-screens. The two 72-inch rolls serve the entire four sections of the mill. Seven sets of skips are used; one set for each 72-inch roll, and one set for each of the five pairs of 54-inch rolls. Dry crushing has the disadvantage of making the interior of the mill very dusty, but exhaust-fans are being installed. Judging from the performance of the first one, they should keep the mill fairly free from dust.

The concentrating department has a primary set of 10 double-deck Garfield tables and 10 Wilfley tables per section. Only two products are made; tailing and concentrate. The concentrate from the Garfield tables is treated on the Wilfleys, which make a concentrate that is shipped. This assays nearly 50% lead. The tailing from both classes of tables goes to a 4-spigot Janney classifier, the first three spigot-products of which are ground from 10 to 50 mesh in tube-mills running on open circuit. Each mill grinds 450 tons per day and is driven by a 50-hp. motor. A shovel-wheel dewaterer supplies the ore to the feed-box of the mill. The tube-mill product is treated on a secondary set of 10 double-deck Garfield tables, followed by 10 Wilfley tables, the wash-water for these tables being the fourth-spigot product of the classifier, together with the overflow from the tube-mill feed-dewatering wheel. Each primary Garfield table handles 300 tons per day or 150 tons per deck. A 15-hp. motor drives the 10 tables. A very simple method is used to carry the feed to the lower deck of these tables. The feed-box for the upper deck has five 2-in. pipes, set vertically and running entirely through it. Pulp to the table is supplied from a stationary feed-box with five spigots, having the same spacing as the pipes in the bottom. While the table is running, the pipes are beneath the spigots half of the time, thereby sending the feed to the lower deck. The concentrate from the secondary Wilfley tables will receive a more extended treatment than it does at present, when the new concentrate re-treatment plant is running. Now four different grades of concentrate are sacked and shipped to the smelter. It is stated that the mill heading averages $1.68 per ton and the recovery is 87%. The total operating cost is given as 64c. per ton. The visitor to this property cannot but be impressed with the magnitude of its operation and with the efficiency of the staff, which has brought a difficult problem to such a successful issue.

This application of copper concentration methods to a gold ore is startling at first glance. But with an ore that cannot profitably be cyanided and that is of such low grade that an enormous daily tonnage must be milled to make the small per-ton profit of economic importance, the innovation has been amply justified.

Filing systems for papers are numerous but two only are worth considering. The Dewey system of decimal classification is used by the United States department in Washington. By this system all knowledge is divided into ten classes and these again subdivided decimally. As applied to a telephone company the divisions are: 000 General, 100 Executive, 200 Finance and Accounts, 300 Construction, 400 Equipment, 500 Operation, 600 Rates. Each of these classes may be subdivided. For example, the heading '300 Construction' is subdivided: 310 Real Estate, 320 Pole Lines, 330 Circuits, Loops, etc.; 310 Real Estate is subdivided thus: 310.0 Purchase of property, 310.2 Construction of new buildings; this heading can be again divided 310.21 Plans and Specifications, 310.22 Contracts for new buildings, 310.23 Interior appointments; this last could be subdivided 310.231 Lighting, and this again into 310.231.1 Electric wiring, and so on to any degree of minuteness. A cataloguer familiar with the system would know that 016.581.974.-742 meant 'Bibliography of the Flora of Albany County, N. Y.' But to the ordinary persons the numbers convey no information, though they tell a definite story to the expert.

Diamonds were first found in New South Wales by E. J. Hargraves, the discoverer of gold, in 1851. The largest diamond yet found is said to have been obtained at Mt. Werong, near Oberon, in 1905, and weighed 28.5 carats. It is difficult to secure accurate statistics of the production of precious stones, but the yield of diamonds in 1912 was estimated at 2240 carats, valued at $10,000. The total production to the end of 1912 is given as 178,971 carats, valued at $600,000.

Graphite production of the United States in 1914 was 4336 tons, worth $324,118. Most of the crystalline, and all of the flake variety, was extracted in New York, Pennsylvania, and Oklahoma. The International Acheson Graphite Co. of Niagara Falls, manufactured 10,455,139 lb. worth $698,800.

Pre-Cambrian Ore Deposits in Ontario

By WILLET G. MILLER and CYRIL W. KNIGHT

*Introductory. During the last decade, owing to the great progress that has been made in the production of metals in Ontario, special facilities have been provided for the study of pre-Cambrian rocks. Our information has been much increased concerning the age relations of the rocks that represent various epochs of this great period, and the ore deposits that are associated with them. It has seemed to the authors that it might now be of interest to present a classification of the pre-Cambrian ore deposits of the Province, showing the various metallogenetic epochs into which the period may be divided. In no other part of the continent or the world has the pre-Cambrian proved to be of greater economic interest. The Province has not only the world's greatest deposits of nickel, among which have been developed mines that compare favorably in economic importance with those of any other metals found elsewhere, but the gold mines and the cobalt-silver areas are recognized as being among the greatest known.

From the following table it will be seen that there have been at least four great metallogenetic epochs during the pre-Cambrian period in Ontario, namely, Grenville, Algoman, Animikean, and Keweenawan. A fifth epoch of importance should probably be added to represent the orebodies associated with the basic intrusives that preceded the intrusion of the Algoman granite and followed the deposition of the Timiskamian sediments. There is proof that many important ore deposits have been removed by erosion, and it seems not unlikely that the rocks of certain epochs, not now productive, contained deposits that have disappeared through the removal of vast thicknesses of material.

GEOLOGIC MAP OF ONTARIO.

Economic Importance of Various Epochs. The table gives the value of the metallic production of Ontario for the year 1913, classified according to age and origin. Considerable nickel, cobalt, and arsenic in the Cobalt ores are not represented in the table, nothing being received for them by the mines. A comparatively small quantity of the nickel and copper should be credited to the deposit in Dundonald township, which is associated with the basic eruptives of pre-Algoman and probably post-Timiskamian age.

It should be understood that the ages given for the deposits do not refer to secondary concentration, as, for instance, in the case of iron ores, but to the epoch in which the metals were first deposited.

While at present there is no production of iron ore from deposits of Animikean or Timiskamian age in Ontario, millions of tons are mined from deposits of these epochs in the state of Michigan.

Since the authors have given elsewhere an explanation of the nomenclature employed in the table, it is not necessary to deal in this paper with the names applied to the various subdivisions of the pre-Cambrian.†

Certain metals may occur in economic quantities in more epochs than the table shows that they do, the authors not having been able to determine definitely the age relations of some deposits.

Sequence of Intrusion and Metal Deposition. The table brings out an interesting alternation of igneous intrusion and sedimentation, and the importance of the igneous rocks in the formation of ore deposits. It will

*Abstract of paper entitled 'Metallogenetic Epochs in the Pre-Cambaian of Ontario,' presented before the Royal Society of Canada, Section IV, May 1915, and prepared by the authors.

†Ontario Bureau of Mines, Vol. XXII, Part 2, pp. 123 *et seq.*, and Geol. Soc. Am., 1914, abstract.

be seen that there are broadly five great epochs of intrusion, basic and acid rocks alternating, namely, (1) Keewatin, basic; (2) Laurentian, acidic; (3) pre-Algoman, basic; (4) Algoman, acidic; (5) Keweenawan, basic, passing in places into a considerable volume of acidic varieties. The pre-Algoman basic rocks are of greater volume and wider extent than they are usually recognized to be, since they are frequently wrongly classed as Keewatin. These basic rocks are represented by the sudburite of the Sudbury area, by the lamprophyres of Cobalt and elsewhere, and apparently by the basic rocks of the townships of Dundonald, Reaume, and others where associated with them are nickeliferous pyrrhotite and chromite.

Owing to erosion, the sequence of metal deposition shown in the table is doubtless incomplete. Iron 'formation' occurs in three epochs, the Grenville-Keewatin, Animikean, and Timiskamian, but is of economic importance only in the former two. Certain deposits of titaniferous and non-titaniferous magnetites, not now being worked, are associated with basic intrusives that appear to be of pre-Algoman age. Arsenic occurs in two epochs and has been produced in economic quantities from rocks of both. In so far as is shown, gold occurs in economic quantity only in the Algoman, although small quantities are obtained in refining the copper-nickel ores, and certain auriferous quartz deposits, not now productive, appear to be genetically connected with Keweenawan intrusives. Nickel, as has been shown in a preceding paragraph, was deposited in economic quantities in two epochs. Cobalt, silver, and copper are produced only from deposits of Keweenawan age. Platinum, palladium, mercury, and other metals are found in small quantities with Keweenawan ores. Zinc and lead have been mined in the Province, but the age relations of some of the deposits are in doubt.

Keweenawan. The basic rocks that are classed as of Keweenawan age are found in numerous localities as dikes, sills, and flows over a vast region in that part of the protaxis occupied by Ontario, Michigan, and adjoining territory; in so far as can be determined at present these rocks are also found far to the northeast in the former territory of Ungava, now part of Quebec, and to the far northwest in the Coppermine River basin and northward to the Arctic coast.

In Michigan and in the Coppermine River country these basic intrusives are considered to be genetically connected with deposits of native copper. In Ontario, along the north shore of Lake Huron, the Keweenawan intrusives appear to have given rise to the deposits of copper pyrite, while at Sudbury the copper-nickel ores and at Cobalt the silver-cobalt veins have been shown to be genetically connected with them.

While it is not the intention in this paper to go into detailed descriptions, there are a few facts relating to the ores that are genetically connected with the Keweenawan basic intrusives that should be emphasized: (1) They contain the greatest known quantities of the two magnetic metals cobalt and nickel and a high percentage of the third element, iron. (2) The deposits are widespread. In the region surrounding Cobalt, silver-cobalt veins are found here and there over an area at least 5000 square miles in extent. Beyond this region cobalt ores are associated with these rocks in the township of Otter, north of Lake Huron, and in small quantities along the shore of the lake opposite Desbarats. Similar ores have been found in Michipicoten island in Lake Superior and in the area tributary to Port Arthur, 500 miles distant from Cobalt. With the effusive rocks of Michipicoten island is also found native copper under conditions similar to those of Michigan and the Coppermine River region. (3) Some of these ores, those of Sudbury, are considered to be a direct segregation from the magma, while the cobalt-silver deposits are less direct, having been deposited from aqueous solutions, although a few veins partake to some extent of the character of deposits formed by segregation from a molten magma.

Animikean. Interbedded with the Animikean clastic sediments are vast quantities of iron formation, a chemical deposit. Through the action of aqueous solutions, concentration of the iron has taken place, giving rise to orebodies of economic importance.

While the iron deposits of Ontario in the Animikie series of the north shore of Lake Superior have not proved to be of much economic value, across the international boundary in Minnesota they are represented by the great Mesabi orebodies.

Algoman. Gold deposits, which are found in numerous localities in the Province, from the Quebec boundary on the east to that of Manitoba on the west, are, in many cases at least, genetically connected with granites to which the name Algoman is applied. In a few cases the granites are represented by more basic rocks. The gold occurs in quartz veins, being associated usually with iron pyrite, but occasionally the ore carries considerable arsenical pyrite, or mispickel. Some of these veins have been worked as a source of arsenic. There are thus two epochs in which arsenic has been deposited in economic quantities: the Algoman and the Keweenawan, represented by the cobalt-silver arsenical ores of Cobalt.

The gold deposits are found chiefly in Keewatin schist, but a few occur in Timiskamian clastic rocks. It is worthy of note that the only gold deposits of the Province that have been proved to be of great economic importance are found in, or in the vicinity of, these Timiskamian fragmental rocks.

Most of the gold in the important deposits, belongs to a time later than the mass of the veins, having been deposited after the veins were disturbed and fractured.

Basic intrusives that appear immediately to precede the Algoman granite are genetically connected with important nickeliferous pyrrhotite deposits in the township of Dundonald and with small deposits of chromite and pyrrhotite, which have not proved to be of economic value, in the township of Reaume. These intrusives have not been proved definitely to be later in age than the Timiskamian sediments, but they appear to be so. If

this is their age, they correspond chronologically with the lamprophyre dikes of Cobalt and elsewhere and with the sudburite of Sudbury. Basic rocks genetically connected with titaniferous and certain non-titaniferous magnetites appear to be of the same age.

As in the case of arsenic, there are thus two epochs of nickel deposition in Ontario, the Keweenawan and that described in the preceding paragraph.

Basic rocks contemporaneous with sudburite are more widespread in the Province than is generally recognized, for they have frequently been classed as of Keewatin age. No age name has been applied to these rocks.

Grenville and Keewatin. Iron formation representing chiefly chemical deposits laid down during Keewatin-Grenville times is widely distributed. In fact, it may be said that there is scarcely a locality in the Province where Keewatin rocks are found that iron formation is absent. The iron formation usually consists of interbanded silica and iron ore, magnetite or hematite, but in places there is considerable siderite, or iron carbonate. Through the action of aqueous solutions on the iron formation workable deposits of ore have been produced at various localities.

Erosion of Ore Deposits. Nearly all the ore deposits

Pre-Cambrian Epochs of Ontario and Their Metal Production	Production in 1913	
Keweenawan		
Epoch, following basic intrusions, of (a) silver, cobalt, nickel, and arsenic at Cobalt and elsewhere, (b) nickel and copper at Sudbury, and copper elsewhere. Some gold deposits, not now productive, appear to belong to this epoch.	Silver	$16,987,377
	Copper	3,952,522
	Nickel	14,903,032
	Cobalt	525,028
	Cobalt and nickel	90,266
	Arsenic	101,463
		$36,559,688
Animikean		
Epoch of deposition of 'iron formation' as a chemical precipitate.	Iron ore	Nil
(Algoman)		
Epoch, following granite intrusions, of gold at Porcupine and at many other localities, and of auriferous mispickel. Deposits of galena, zinc-blende, fluorite, and other minerals also appear to have been derived from granite, but some of them were not formed till post pre-Cambrian times. Preceding the intrusion of the Algoman granites, basic intrusives, that appear to be of post-Timiskamian age, gave rise to nickel and titaniferous and non-titaniferous magnetite deposits and chromite.	Gold	$4,543,690
Timiskamian		
Epoch of minor deposition of 'iron formation' as a chemical precipitate.	Iron ore	Nil
(Laurentian)		
Granite intrusions probably gave rise to ore deposits that have been removed by excessive erosion as is known to be the case with deposits of later origin.		Nil
Loganian		
Grenville and Keewatin	Iron ore	$ 237,976
Epoch of deposition of extensive 'iron formation' as a chemical precipitate among other sediments.	Iron, pig	975,174
		$1,195,150

Timiskamian. No ore deposits are known to have been formed during Timiskamian times in Ontario. It may be added that on the United States side of Lake Superior rocks that appear to be of Timiskamian age contain extensive deposits of iron formation, with which are associated orebodies of commercial importance.

Erosion has removed by far the greater part of the Timiskamian rocks that once were widespread in Ontario, and it is possible that ore deposits of this epoch have also been destroyed.

Laurentian. No orebodies that are genetically connected with Laurentian granite and gneiss are known to occur in the Province, but as rocks of this epoch that are now exposed at the surface represent originally deep-seated material, from above which thousands of feet have been eroded, it is impossible to say that orebodies of Laurentian age have not been destroyed.

of the Province have been subjected to excessive erosion. The few exceptions that are known are represented by so-called 'blind' veins or those that do not come to the present surface, such as a small number of silver veins at Cobalt.

While it is not possible to determine the total amount of erosion to which the pre-Cambrian surface has been subjected during various epochs, since the Keewatin-Grenville rocks appeared above the surface of the primeval ocean, it can be proved to be enormous.

In pre-Timiskamian times the Keewatin-Grenville rocks were eroded to a great depth, as is shown by the thickness of the Timiskamian sediments, and the deep-seated Laurentian was exposed at the surface.

Again, in the epoch that gave rise to the Animikean sediments, erosion of all the older series was excessive and long continued. The folded Timiskamian frag-

mental rocks were cut down until they were represented merely by comparatively narrow belts in some localities, while over large areas no remnant of them remained. During this epoch the Keewatin, Grenville, and Laurentian again were subjected to great erosion.

In post-Animikean and pre-Paleozoic times there was a great erosion epoch. This is shown by the outlier of the Cobalt series, and the intrusives that penetrated it.

Since Paleozoic times there has been again much erosion, so that the Cambrian, Silurian, and Devonian strata have been removed over vast areas, exposing the underlying pre-Cambrian.

That many ore deposits of various ages have been destroyed during the several epochs of erosion is evident. Two or three hundred feet more of erosion would have left comparatively little, for example, of the Cobalt silver deposits, of which doubtless more has been eroded than has been mined, or of the great Mesabi iron deposits of Minnesota.

In considering the relation of ore deposits to erosion in the pre-Cambrian of Ontario it appears that workable ore deposits are confined to near the surface.

Complete erosion of certain series of rocks, it would seem, may account for the absence of ore deposits in those countries where the pre-Cambrian, although occurring in considerable volume, is barren. For instance, in the northwest highlands of Scotland there is evidence that fragmental series, probably corresponding to the Timiskamian and Animikean of Ontario, were completely eroded before the deposition of the Torridonian, which is considered to represent the Ontario Keweenawan. If we except the Moine or Eastern schists, the age relations of which are doubtful, the rocks now remaining in the Scottish pre-Cambrian appear to represent the Keewatin and Grenville, with the deeply eroded roots of intrusives, and the Keweenawan. If all the sedimentary series that lie between Keewatin-Grenville and the Keweenawan had been removed by erosion in Ontario, there would be nothing left of the orebodies that are now found enclosed in Timiskamian and Animikean rocks or in the intrusives associated with them, and the deposits of whatever age enclosed in the Keewatin and Grenville would also have largely disappeared.

Faulting and folding have preserved parts of orebodies that otherwise would have been completely destroyed by erosion. This is well illustrated by the Cobalt Lake fault, where silver veins have been protected on the down-throw side of the fault. Had it not been for this fault, and others associated with it, practically all the ore that has been mined in the vicinity of the fault and to the west of it would have been removed. Folding at Kirkland Lake and Porcupine has preserved comparatively narrow synclinal belts of Timiskamian sediments and the weathered Keewatin rocks that immediately underlie them, and at one time formed the surface of the earth. There is no reason for believing that erosion has been less in the two localities mentioned than elsewhere in the pre-Cambrian, but probably the character of the rocks, all of which were at one time, before folding took place, subjected to surface influences, has a bearing on the formation of openings and the deposition of ores. The gold deposits are found both in the Timiskamian sediments and in the Keewatin, the more schistose and more highly altered varieties of the latter group appearing to be the greater economic importance.

The French Zinc Process

This process consists in dissolving the zinc from a roasted ore by means of bisulphate of soda, to which a little manganese (oxide?) has been added, according to an anonymous writer in the *Nelson Daily News*. The zinc is then precipitated electrolytically.

The process is now being worked by the Standard Silver-Lead Mining Co. at Silverton, Slocan lake; the plant contains two completely equipped dissolving vats each capable of dealing with a charge of 2500 lb. of liquor and about 1000 lb. of ore. The zinc-depleted liquor containing bisulphate of soda from the electrolytic vat is pumped into the upper of these two vats. There is then added 700 to 1000 lb. of roasted ore from which the zinc has been partly extracted in a previous operation. In about an hour the solution of the zinc is finished and when the liquor has settled for a short time it is allowed to run down into the second dissolver, placed at a lower level. The sludge remaining in the bottom of the dissolver is then pumped through a filter-press to remove the water and the residue contains all the silver and lead. As the sulphur to the extent of more than 20% has been driven off in the roasting operation and zinc to the amount of about 40% has been extracted, the residue of the ore, of which a large quantity was treated, only weighed about 45% of the original ore. As it contained all the silver and lead originally in the roasted ore, the proportion of these metals was more than doubled. For instance, the ore treated had 31% zinc, 3.5% lead, and 32 oz. silver per ton. The zinc depleted residue contained 76 oz. silver per ton, and 8.7% lead, and 92% of the zinc had been taken out, that is, 2.7% of the zinc counted on the original ore was left in the residue. This residue is now ready for smelting or other treatment for the recovery of its lead and silver in the usual way. To the liquor that has been run down into the second dissolver, a quantity of roasted ore is again added to neutralize the bisulphate of soda. As soon as this has taken place the liquid settles rapidly to a clear solution, which is pumped through a clarifying filter-press, and is then ready to have its zinc deposited in the electrolytic-vats. At the Standard Co.'s plant only one electrolytic-vat was used, as the dynamo-power at disposal there was limited. Nine anodes were used and eight cathodes of the largest size each with an area of 8 sq. ft. What can be done with one vat can be done with any number on a large scale, a reduplication of vats of the same size being all that is necessary. The plant was well designed and erected and the results of running a large quantity of ore gave a remarkably good current consumption.

PALACE OF MINES AND METALLURGY.

Mining and Metallurgy at the Exposition

Engineers attending the meeting of the International Engineering Congress at San Francisco, during the period September 16 to 25, will find much of interest in the Palace of Mines and Metallurgy at the Panama-Pacific International Exposition. Some may be disappointed; others may consider it worthy of a great industry; we leave judgment to the visitors. If the original plans had been carried out, the place would be a hive of industry; however, things must be accepted as they are. Mine equipment is not complete without power, so engineers must step across the Avenue of Progress to the Palace of Machinery to see some of the latest prime-movers. The centre of attraction in the mining department is 'The Mine,' and as sections of some of the greatest mines in the country are represented, this should be the starting point for further exploration of the exhibits. This excellent model mine was constructed under the supervision of the U. S. Bureau of Mines, in co-operation with the mining companies represented.* The underground workings may be entered by an electrically-operated hoist, or by walking down the incline or slope. Mining men will feel at home as soon as they enter on account of the characteristic odors of decaying timbers and wet rock found in real mines. The excavation is below sea-level, but continuous pumping saves it from being flooded. In the small space occupied by the mine, the zealous student can learn more of underground mining from the exhibits and the courteous explanations of the white-capped young engineers than he could by months of hard study under the ablest of professors. Here are illustrated most of the methods and machinery used in coal and metal mines.

As you descend the well-worn steps of the incline, you need light to illuminate the darkness, and there is a choice of electric, oil, or acetylene safety-lamps, or an ordinary lamp. Should you need to resuscitate an asphyxiated person, the lungomotor is at your service. At your left, as you advance, is a Hercules powder-magazine with enough alleged dynamite to blow the whole building through the Golden Gate. The powder-magazine is not properly situated; in an actual mine it would not be in a cross-cut opening directly into a main gallery, but would be around at least two corners, so that the force of a possible explosion would expend itself on the rock-faces, and not on the unfortunate miners.

A little beyond the powder-magazine the first real mining appears. This consists of a completely timbered stope from the Goldfield Consolidated mine, in Nevada. Ore lies on the floor as if just broken. A small drill is ready to commence on a raise.

Next comes a model of the system of mining in vogue at the renowned Homestake, in South Dakota, one of the world's greatest gold mines. It has paid $35,000,000 in dividends, and yet there is 30 years' ore developed. At present the mills are crushing 4500 tons of $4 ore daily. This carefully made model, if correctly understood, conveys as much information as a good-sized volume on mining methods. It illustrates the working of a wide vein of low-grade ore by shrinkage-stoping. By a complexity of drifts and cross-cuts the 500-ft. wide zone of schist and quartz is divided into blocks 500 ft. wide, 60 ft. long, and 150 ft. high. This block is shot down in pieces up to 50 tons in weight for a height of 115 ft., and allowed to remain where it falls, without the use of

*See also 'The Mine—An Educational Exhibit,' by the Editor, M. & S. P., May 1, 1915.

timber. The 35 ft. separating this stope from the ground above is worked by means of square-sets, and then the whole stope is filled with waste. A mat of heavy timbers supports this waste and allows it to settle gradually. This is an admirable model and should be secured by one of our universities. Sample of ore and rock from the Homestake are also on view.

One would think that the Bunker Hill & Sullivan company had bodily transferred one of its stopes from Idaho to the Exposition. The placing of this lead-silver ore (8% lead and 8 oz. silver) took a mining engineer and his assistant two months; the total expense of this small exhibit was $5000. This reproduction of an actual working-face is excellent. The facility for artificially constructing an orebody has often been used for fraudulent purposes in various parts of the world. In one case an expert found that the mine had been gutted behind an artificial wall a few feet thick; in another the perpetrators of the fraud were victims of their own lack of faith, as the would-be victims eventually found rich ore. This was in a noted silver-lead mine in Nevada, some 50 years ago. The Bunker Hill exhibit shows an ordinary waste-filled stope, a much commoner system than that of the Homestake. Among the photographs on the wall, those that show the wreck of the Wardner mill after it was dynamited on April 29, 1899, by a thousand or more miners who came on a captured railway train, and the photograph of the ill-famed 'bull-pen' in which several hundred miners were subsequently imprisoned, should be of special interest to students of our industrial history. A Baldwin-Westinghouse storage-battery (Edison) locomotive, hauling two 25-ton cars of ore just filled from a chute, is ready to pass out of the level. On the lower levels storage-batteries are used; trolleys appear in the main adit.

Copper men have their turn next at the Copper Queen mine, Arizona. There a stope, ore-chute, man-way, timber-way, and timbering are shown; also faces of ore in place, slabs weighing a ton or more each being brought from Arizona. Specimens are exhibited of tenorite and melaconite in kaolin, chalcocite and pyrite, chalcopyrite and bornite, cuprite and malachite in iron oxide and kaolin. This exhibit cost $10,000.

Iron mining is shown by workings of the Lincoln mine at the great Mesabi range, Minnesota.

The black coal mines seem gloomy when contrasted with the bright ores of the Copper Queen. Reproductions of the anthracite mines of Pennsylvania and the bituminous mines of Kentucky, West Virginia, Wyoming, and Washington contain various coal-cutting machines, electric locomotives, drills, cars, safety-exit, manway, automatic mine-door, and other appliances used in such mines.

Between the metal and coal displays is a station where a motor-driven compressor supplies air for the drills, a centrifugal pump for draining the mine, a winze with sinking-pump and small hoist, and a Waugh drill, which occasionally bores a hole in a block of concrete. Fresh air from the surface is introduced at this station by a Sirocco fan working near the collar of the main shaft. A fuse magazine, a cap and fuse exhibit of the Ensign-Bickford Co., underground foreman's office, and a motion-picture theatre where actual mining scenes are shown, complete the workings.

The fact that the Bureau of Mines has reduced the cost of producing radium to $36,050 per grain of bromide will perhaps make a visit to the radium booths more interesting.

At 2 p.m. each day, save Sunday, the mine crew of the Bureau gives an exhibition of rescue-work and first-aid. A violent explosion occurs; protected by their Draeger helmets and store of oxygen, the rescuers enter a room full of poisonous gases, rescue a supposed victim of the explosion, resuscitate him by the most approved methods, and finally leave him in charge of a surgeon and nurses in the complete hospital near at hand. The Proto and Westphalia rescue apparatus are also ready for emergency.

The Bureau's exhibits on the main floor of the building include lantern-slide pictures, a gas-proof smoke-room to test rescue-appliances, a collection of ingredients used in the manufacture of explosives, and samples of the final product, welfare demonstration, a map showing the position of the Bureau's rescue-cars and stations in the East, apparatus to minimize the explosibility of coal-dust, operating devices showing the losses that occur in burning coal in various types of boiler-furnaces, and many other instructive arrangements, including photographs of mining and metallurgical activity.

With the co-operation of the American Smelting & Refining Co., the Anaconda Copper Mining Co., Phelps, Dodge & Co., the International Nickel Co., the Thiogen Co., the Braun Corporation, and the Nevada Mine Owners' Association, the U. S. Bureau of Mines has fitted up a complete testing laboratory. Smelter-fume investigation and cyanide problems are the principal subjects at present. In the former, the solid particles have been studied, while the gases are yet to be investigated. The apparatus includes Braun laboratory appliances, a model bag-house given by the Mammoth Copper Co.; from the Western Precipitation Co. came a model of an installation at the Trail smelter, in British Columbia, and a working unit capable of dealing with 500 cu. ft. of gas per minute; a Wedge multiple-hearth roasting-furnace; a Dwight-Lloyd sintering-machine and product; and a complete assaying and chemical laboratory. For instruction of visitors various mill and refinery products from the Homestake mine, plans of smelters, and assaying are described graphically.

Adjoining the Bureau laboratory is a cyanide-plant, which can be operated to suit any tests being made by the Bureau staff. The visitor can see the operation of an 18-in. by 4 ft. 6-in. Hardinge, motor-driven, herring-bone-gear, conical pebble-mill in closed circuit with a simplex Dorr classifier. The Dorr company also has three 6 by 8-ft. tanks, serving as thickener, agitator, and thickener respectively. Less than 1 hp. drives the gear. Slime from this plant can be pumped to the Merrill

Metallurgical Co.'s installation of an automatically-sluiced slime-press of 30-ton capacity per day, a new type of solution clarifier, precipitation-press, and zinc-dust feeder. Byron Jackson stage-pumps move the solutions and pulp. Adjoining this plant, but not connected with it, is a complete Oliver continuous filter, treating heavy flotation concentrate from the Anaconda company's Washoe plant.

In its endeavors to instruct the engineer and layman, the U. S. Geological Survey has an extensive exhibit near the Bureau of Mines. This includes examples of the work done by the various departments of the Survey, and pictures of field-work, indicating how, where, and why it was done. Cases contain maps of the coal-fields of the United States, samples of coal, and details of age, number, and thickness of beds. Other cases contain samples of minerals and products reduced from them, and brief descriptions of their use. After seeing these the visitor can wander among maps, field-instruments, stream-flow instruments, drafting materials and instruments, and models showing the activities of the Survey.

"Alaskans please register" is the sign in front of the Alaskan exhibit, adjoining that of the Survey. A golden cube, about 9 ft., represents the Territory's gold output from 1880 to 1914 inclusive, a total of $244,156,799. Samples of gold, silver-lead, and copper ores, and coal are shown in several cases. Mention of copper is interesting, as this year it is expected that the Kennecott company's mines will produce 70,000,000 lb., a figure close to some of the greatest copper mines in the United States. A section of a Sitka spruce, 7 ft. diameter, gives an idea of the growth of timber; so also the furs, grasses, grain, fruit, vegetables, and the skin of an 11-ft. bear illustrate other resources of the territory.

Millmen should not miss an inspection of the Pacific Tank & Pipe Co.'s manufactures, the Senn concentrating-tables, the Trent cyaniding apparatus, and the Straub circular 10-stamp mill.

Only the States of California, Idaho, Missouri, Nevada, New York, and Oregon have made a mining and metallurgical display. The Anaconda exhibit may be said to represent the greatest centre of activity in Montana. Alaska has been described above. Principal features of each are as follows:

California. Cases containing ores and minerals from several counties, placer gold, a model of the Mammoth copper mine, metals, photographs of mining scenes, a model hydraulic mine in operation, a Hendy full-size giant, a model electrically-driven Yuba Construction Co.'s dredge, and a peg-model of the Sunset-Midway oilfield. Geologists should not fail to examine the last.

Idaho. An area of 49 by 61 ft. contains 250 samples (one piece weighs 3860 lb.) of gold, silver, lead, copper, zinc, and rarer ores. The well known Sawtooth mountains form a background. Mill-products and photographs explain the activities in many directions.

Missouri. Zinc and lead naturally occupy large space in this booth. These products of the State are valued at about $30,000,000 per year. The famous Joplin zinc district is thoroughly explained by a mine-model, drill-cores, ores, a complete operating 25-ton mill, and zinc manufactures. The lead area displays ores, four tons of pig-lead, and sublimed lead products.

Nevada. The excellence of this exhibit is shown by the prizes given to it by the Exposition Jury of Awards. Nevada is essentially a mining region, a normal year's metal output being nearly $40,000,000. Some famous gold, silver, and copper mines are situated within the State. The display is instructive in its relief map, cases of rock and ore, mine-models, geological maps, flow-sheets of mills, panorama of mining districts, and cubes representing outputs of the various metals. Specially interesting are the platinum ores from the Boss mine.

New York. The booth of this State is likely to be overlooked, as many people do not know that the annual output of minerals is over $40,000,000. Indeed, it is an interesting display, largely from a metallurgical point of view. Lime, cement, talc, magnetite iron ores, pyrite, oil, garnet, carborundum products made at Niagara Falls by the Acheson process, graphite ore and graphite products from the Joseph Dixon Crucible Co.'s mines and mills, a model of the Sterling salt mine at Halite, with the grades of rock-salt made, an instructive diagram of the Solvay ammonia-soda process at Syracuse, and other things make the whole worth a visit.

Oregon. Considering the relatively small production of gold, silver, and copper in this State, the display is creditable. Dredging men will be interested in the coarse, flaky gold recovered by the only boat, the Powder River dredge at Sumpter. Gold-silver ores from mines in Baker, Grant, Josephine, and Malheur counties show the varied character of the district. Useful building-stones are on view.

Montana. Copper men would expect a good exhibit by the Anaconda company of Montana; in this they will not be disappointed. The floor-space is 3500 sq. ft. The exhibit has been arranged to take the visitor step by step through the various processes that the ore undergoes from the time it is taken from the mine until the finished wire-bar, cake, or ingot copper is shipped to the consumer. The geology of the Butte district is shown by plans and models of mines. Large specimens of ores show the association of minerals. More models illustrate mining methods, timbering, and head-frames. Wet concentration, smelting, and their products are explained by display-bottles and a complete collection of common shapes of refined copper.

Lead miners and millmen will be particularly interested in seeing their metal reduced to a product that consumes a great deal of the lead output, namely, white lead. A complete plant, using the Dutch process, is in operation, the exhibit of the W. P. Fuller Co., San Francisco. Behind it is a multi-colored Moorish pavilion, showing artistic taste in construction and in the use of paint.

For the reduction of tin concentrate from Bolivia, a smelter is now being erected in the East, so the extensive

display of tin ores from that country may be studied with profit.

The Argentine Republic is not generally connected with much mining, but the large and well arranged lot of samples of ores, rocks, oils, etc., will surprise even those well informed concerning South American resources.

As in many other departments of the Exposition, Japan is prominent in the Mines building with an excellent assortment and display of coal, ores, and metals from a number of important mines. The Japanese government co-operated with the large mining companies, including the Mitsu Bishi & Co., Mitsu Mining Co., Kuhara Mining Co., Imperial Steel Works, Hokkaido Colliery & Steamship Co., Nippon Oil Co., and the Japan Sulphur Co. The Imperial Geological Survey's collection includes minerals and fossils of the islands, supplemented by the economic minerals.

Chemists will find the Stauffer Chemical Co.'s exhibit of various acids, alkalis, and paints of interest.

A golden obelisk and two golden spheres are prominent objects in the centre of the building. They represent the gold output of the Witwatersrand compared with other countries and the rest of the world, respectively. In 1914 the Rand contributed 38.3% of the world's total of $446,500,000. A model of the surface equipment of the Modder B mine shows the typical Rand arrangement of plant. The peculiar 'banket' ore from the 'reefs' will attract attention, so will the many photographs of the principal properties.

The oil production of California was approximately 100,000,000 bbl. last year, valued at $50,000,000, or 50% of the total mineral output. It is therefore fitting that a good deal of space is devoted to various phases of oil production. The models of the Lakeview oilfield, Section 36 of the Midway field, and the Richmond refinery, all shown by the Standard Oil Co. of California, are full of interest. So is the large map of the United States on which are marked oilfields and pipe-lines. Few people realize that a continuous pipe-line connects New York and the Gulf of Mexico—near Beaumont—a distance of about 2500 miles. An important device invented by the Standard's engineers is that for excluding water from oil-wells. This is of the utmost importance to oil-producers, millions of dollars having been wasted for want of a similar system in districts that have been ruined by the influx of water into the wells. A collection of fossils, some under small microscopes, characterizing the oil formations, is shown. Road-building materials are explained by those in charge of the exhibits. The section of 10-in. pipe, with tools for its construction, gives some idea of the great work necessary in the transportation of oil. The uses of petroleum are manifold. The most recent product is a colorless, odorless, tasteless 'petrolatum,' used for lubricating the human digestive tract; the war having stopped the importation of this product from Russia, it is now made in America for the first time.

Adjoining the Standard Oil display are four gigantic dinosaurs guarding the model of the Lakeview gusher in the exhibit of the Union Oil Co. These lizards lived in the Cretaceous period. They have been constructed to testify that the officials of the company believe in the organic origin of oil—a theory that has the support of most scientists. The Lakeview was the greatest of Californian gushers, its maximum production was 75,000 bbl. per day, and a total yield of 10,000,000 bbl. This is a large quantity of oil, but was greatly exceeded by the Baku wells in Russia, where the early operators were ruined by the rivers of sand that flowed from their wells and covered valuable farm-land.

It is fitting that the United States Steel Corporation, which employs 228,000 men, and has an income of over $519,000,000, should occupy 42,000 sq. ft. (nearly an acre) of floor-space, one-fifth of the entire Mine building. Models of furnaces, mines, ore-docks, and many models of towns give a slight idea of the extent of its activities. Safety-first signs in many languages, and photographs of safety-devices, show something of the watchful care for employees. A pamphlet contains reproductions of hundreds of photographs of houses with gardens, kindergartens, pensioners, cooking-schools, and sanitary arrangements from primitive to complex. For the mining engineer the model of the Sauntry-Alpena open-pit mine is awe-inspiring in its immensity, with the steam-shovels and railway trains. As you study these gigantic mines soft waves of music flood you with harmony. They come from an organ and harp that contain pipes and wires made by subsidiary companies of the Corporation. Motion pictures of mining, transportation, smelting, and manufacturing iron and steel are shown for eight hours each day. The whole exhibit requires hours of study.

New labor laws, which include hours of working, wages, and compensation for injury, are much discussed by mine-owners at present, and to those of a statistical turn of mind, the Prudential Insurance Co. offers a series of 200 charts dealing with disease, death, and other cheerful subjects connected with life insurance. The method of showing the combination of three variables on a plane surface is ingenious, and worthy of the attention of the mining engineer. For example, one of these charts shows the weight, age, and number of deaths from tuberculosis; by the side of this hangs a chart showing similar statistics for heart disease. The differences between the sufferers from these two diseases is brought out with startling clearness. An interesting pamphlet gives the documentary history of insurance. The earliest recorded legislation, the Rhodian sea law of 1000 B. C. still governs the construction of all maritime contracts to the present day. The Aetna Insurance Co. displays a number of safety-first devices.

The object of most work is monetary gain, and a model mint is in operation in the building, at certain hours of the day. Here may be seen bars of gold, silver, copper, and nickel used in coining; a gas-fired melting-furnace, rolling-mill, strip-shears, cutting-press, annealing-machine, washing barrel, and a minting-machine. During August this plant coined $100,050 of $50 pieces.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Copper containing about 10% nickel has a high tensile strength, with high ductility and reduction of area.

Cyanicides are substances that decompose active cyanides, forming compounds which are not solvents of gold and silver.

Square-set and shrinkage-stopes are probably the easiest to ventilate. This has been found to be the case at the Copper Queen mine.

Amalgamation of gold and silver ores accounts for 8% of the United States quicksilver production. California mills use over 50% of this amount.

Most of the oil produced in northeastern Mexico is from gushers, over 90% coming from about six wells. Under present conditions a pumping-well in the Republic is not commercially profitable.

Tin, tungsten, uranium, tantalum, niobium, and probably molybdenum, occur more frequently in acid rocks, while iron, manganese, nickel, cobalt, chromium, and platinum occur more generally in basic rocks; the two last particularly in peridotite.

Heating solutions to 90° temperatue at the Tonopah-Belmont mill, in addition to increasing the ultimate extraction about 2%, facilitates the coagulation of the slime, being of benefit in the settling and increasing the rate of percolation in the final filtering.

Frozen ground in Alaska varies in depth; it is less on the ridges than in the valleys. A shaft sunk on the ridge south of Eldorado creek reached unfrozen ground at 60 ft., while one in the valley of the same creek was stopped by running water at a depth of a little over 200 ft. The ice is of great advantage from the point of view of pumping.

Fracture in rocks results from tension, compression, and torsion. Tectonic fissures arise from causes outside the rocks in which the effect is produced. These are called 'exokinetic' and generally occur in connection with orogenic, or mountain-making, processes. 'Endokinetic' fissures depend upon causes arising within the rock itself.

Experience in ventilation at the Copper Queen mine has shown so far that in poorly ventilated areas, comfort, efficiency, and economy are obtained in increasing the natural air-supply with mechanical means until the following conditions are obtained: temperature, 77° F.; relative humidity, under 85%; velocity of air in working places at least 100 ft. per minute; volume of air in working places at least 250 cu. ft. per man, per minute. This may be termed a good working atmosphere and is the present standard for mines at Bisbee.

Three prime requisites necessary for the combustion of gases discharged in the fire-box of a boiler are as follows: (1) a sufficient supply of free air in the fire-box and intermixed with the gases; (2) a sufficient temperature at the point and moment of ignition; and (3) sufficient room for the expansion of the burning gases during the act of their combustion.

Estimates of the thickness of the earth's crust have been made by comparing the rise of temperature in depth with the rise of the melting-points of minerals under pressure. The results thus obtained vary between 25 and 90 miles. According to the view generally accepted, both pressure and temperature gradually increase toward the centre of the earth. The conclusion may consequently be drawn that in the interior the critical temperature of all compounds will be passed. According to Arrhenius the material present will, on account of the tremendous pressure, be in an extremely viscous condition, which he described as that of gases compressed to the rigidity of iron.

The oil-deposit in the Furbero field, State of Vera Cruz, Mexico, is of a type hitherto unknown. The igneous nature of the so-called 'sand' encountered in drilling was not recognized until a number of wells had been drilled. It was not until recently, according to E. Degolyer, that the geological relations of the sill or laccolith, which gives rise to the accumulation of oil, were known and the so-called 'anticline' was found to be, in part, the result of igneous intrusion. The determining factor in the accumulation of oil has been the providing of pore space for a reservoir by the metamorphism, accompanying the igneous intrusion, of the under or overlying shale, which were previously impervious.

Rats have been fed by the Chinese in their coal mines as guardians. When there is danger the rats leave the mine, and the miners, noticing this departure, flee also and are saved. From a French paper we learn that an inventive American has made the rat even more useful in coal mines. This use depends on the susceptibility of the rat to fire-damp and other poisonous gases. A vigorous rat is chosen and put in a cage containing a treadmill that is connected with a little dynamo. When the rat runs on the tread-mill the electric current generated lights a lamp; a morsel of strong-smelling cheese is the attraction for the rat. As long as the rat is well, he runs and the lamp shines, but when the gas weakens him the light grows dim. Thus the proportion of gas can be told by the candle-power of the lamp. If the lamp goes out, it is a sign that there is danger, and a general alarm is given. Naturally the rat does not work all the time, but has his regular shift; so several rats must be provided. In order to keep the rat in good condition his food must be carefully regulated; overfeeding makes him lazy.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

GOLDFIELD, NEVADA

JUMBO EXTENSION, MERGER, AND REORGANIZED KEWANAS MINES DEVELOPMENTS.

Ore shipments from the Jumbo Extension mine continue at the rate of 80 tons per day, averaging $40 to $50 per ton. Two developments of interest have been reported during the past week. The shale-contact ore-channel has been penetrated by a south cross-cut from the 526-A raise, being the farthest point to the southeast at which the contact-channel has been exposed and the farthest workings in this direction. The cross-cut shows a face of ore assaying over $60 per ton. This discovery establishes the continuity of the rich ore for a considerably longer distance than had been proved, and affords further evidence that the course of the ore-channel is southeast, directly toward the southern part of the Sunflower claim of the Merger Mines Co. In earlier development it appeared that the ore must extend almost directly south, toward the St. Ives claim, and the trend farther to the east is important to the Jumbo Extension company, as it gives the latter more than 200 ft. greater distance on the ore. The new find, with intervening raises and drifts, proves this orebody over a distance of more than 550 ft., on the dip of the shale, below the new branch raise above the rich 524 drift, on the 880-ft. level. The elevation of the new discovery makes it doubtful if the Jumbo Extension will find the contact ore at all on its 1017-ft. or deepest level, and it is thonght that it may pass out of the Velvet claim and into the Sunflower above this depth. This, however, would facilitate the extraction of the ore within Jumbo ground, as it would involve no sinking below the present bottom level of the mine. The second discovery of importance has been made near the centre of the more fully developed part of the mine. In developing the main ore-channel, south and east of the first discoveries, raises were driven from the southeast cross-cut, within the shale, on the 1017-ft. level. Raise 503-A was driven to connect with the main 921-ft. level, where rich ore was first found on the shale-contact. Raise 503-B exposed the ore, on the contact, near the point where the main lode enters and appears to form a wide fissure within the shale. Some of the richest ore was found here. Raise 503-C penetrated this fissure and progressed for 18 ft. in ore of good grade. For a width of 12 ft. the ore was of medium grade and the remainder, 6 ft. on the hanging-wall side, was very rich at this point. Raises D and E have since been driven to the contact, exposing high-grade ore, the series of raises covering a distance of over 350 ft. An east cross-cut from the 503-C raise was recently started, 45 ft. above the 1017-ft. level and into the shale foot-wall of the fissure, below the pay ore. This cross-cut has demonstrated a more extensive fracturing of the shale than was suspected to exist and a high degree of enrichment throughout the fractured area, the cross-cut having exposed ore of excellent grade well within the shale. Mr. Turner regards this discovery as significant, and it may lead to additional ore in this part of the mine. The great width of the contact ore-channel is further attested by good ore found in new workings from a raise 150 ft. west of the Velvet boundary, in the Paloverde claim, approximately 400 ft. west of the new discovery in the south cross-cut. Stoping is confined altogether to the ore within the shale, as the ground about these stopes is moving, and all ore that will yield a profit is being extracted here, in order that the stopes may be filled and the ground be properly preserved for the future extraction of lower-grade ore. A cross-cut will be driven on the 1017-ft. level, from the south end of the south cross-cut, near the southwest corner of the Paloverde claim, across this claim and a large part of the Velvet claim, and to a point under the Velvet shaft, which is now being sunk to reach the 1017-ft. level. This shaft, for which high-class equipment was provided, has passed the 400-ft. point, and should be completed by the end of the year, when the hoisting capacity of the mine will be more than doubled.

In the Merger Mines property the east drift on the 1175-ft. level, which had been following the shale contact in quest of the Jumbo Extension ore-channel, and which entered a hill of shale, has again penetrated the contact zone. From present indications in the Jnmbo Extension workings, it appears likely that the Merger will be compelled to drive considerably farther than was formerly supposed to reach the Jumbo orebody.

Interest is gaining in the Reorganized Kewanas company's property as the result of a discovery made during the week. A cross-cut driven east from the north drift, in the latite, has exposed a vein that shows a seam from 2 to 3 ft. wide, assaying around $28 per ton. This may prove to be within the shale contact-zone, as the workings have been on the shale, only having lately left the shale, and have been progressing through latite. The ore contains some copper, and is said to be similar to that of the Jumbo Extension. The work of the Kewanas company is conducted through the Laguna shaft of the Goldfield Consolidated. A cross-cut was driven east, into Kewanas ground, at the 700-ft. level of the Laguna, and a winze was sunk 140 ft. where it exposed the shale and where the lateral work of the Kewanas has been carried on.

CRIPPLE CREEK, COLORADO

GOLD OUTPUT.—ISABELLA PRODUCTION.—ORE-HAULAGE RATES.—RICH ORE IN THE CRESSON AGAIN.

The estimated production of the district in August, as reported by mills and smelters, is as follows:

Where produced.	Tons.	Average value.	Total value.
Golden Cycle, Colorado City ..	38,000	$19.00	$722,000
Portland, Colorado City	10,500	21.00	220,500
Portland, Cripple Creek	19,600	2.59	50,764
Portland-Independence	11,000	2.60	28,600
Kavanaugh-Jo Dandy	1,000	1.60	1,600
Gaylord-Dante	700	4.00	2,800
Smelters, Pueblo and Denver ..	4,000	55.00	220,000
Total	84,800	$14.69	$1,246,264

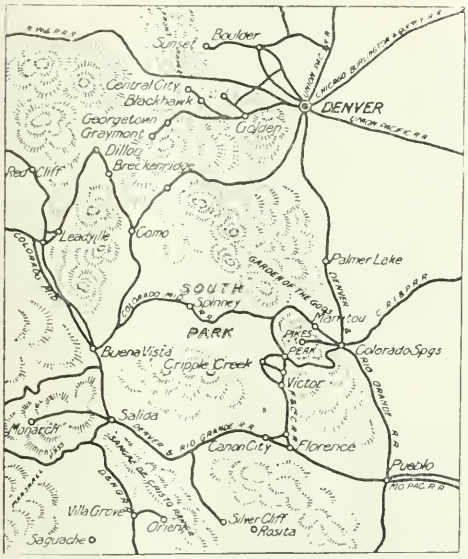
The tonnage was one of the largest recorded; the grade was somewhat lower. The Gaylord and Kavanaugh were the only small mills in operation, and they were not worked full time. It is expected that the Ajax and Jerry Johnson mills will be running before the end of September.

The period has been a busy one at the Isabella mine. It is reported that about 100 cars of ore were shipped. The superintendent Mr. Mitchell, claims that this quantity exceeded by 15 cars any other monthly production since he was placed in charge.

In a recent decision handed down by the Public Utilities Commission of the State of Colorado, the Cripple Creek and Colorado Springs railway has been ordered to reduce its rates

on ore of a greater value than $20 per ton so far as connected with mills in the Cripple Creek district. This means that on ore having a value of $20 or over, the Commission has decided that the rate of delivery to the mills be 25c. per ton less than that charged for hauling the products of the mines to the mills at Colorado City. The new rates will become effective not later than September 19, 1915.

It is reported that another rich development has been made in the Cresson mine. While little inside information can be secured, there is no doubt that the company is sacking high-grade ore. It is very probable that it is the downward extension of the famous shoot found last fall at 1200 feet.



MAP SHOWING RAILROAD FROM CRIPPLE CREEK DISTRICT TO COLORADO SPRINGS.

LORDSBURG, NEW MEXICO

NORMAL WORK IN THE STATE.—CHINO AND BURRO MOUNTAIN COPPER MINES.—MOGOLLON ROADS.—EIGHTY-FIVE MINE.—STEINS, PINOS ALTOS, HANOVER, AND RED RIVER DISTRICTS.

Steady progress has characterized the larger mining centres of New Mexico during the past six months; there has been no noticeable increase in the State's mineral production, neither has there been any decrease.

The Chino company is treating nearly 8000 tons of ore daily. It is making general improvements at its power-house. The company is also working on a new wage-scale, employees being paid according to the price of copper.

The Burro Mountain Copper Co. is making rapid progress at its new townsite, grading being under way at present. The spur to the site has been completed, and supplies are now being hauled over it. The 1000-ton mill is under construction, and steel framework erection is employing a large number of men at the mine. It is probable that the company will add to the list of Phelps-Dodge producers by the first of the new year. A recovery of about 79.80% of the metal contents of the Burro Mountain ore is expected. The company is over-run with labor of all classes, and men seeking positions are warned away from Tyrone.

In the Mogollon district of Socorro county the mines are maintaining their usual output of gold-silver concentrates and bullion. Several important transactions in the purchase of property have been made, but this has not materially affected the mineral output of the Mogollons. A question of importance to the operators is that of more adequate transportation facilities as mentioned in the PRESS of September 1. Three entrances into the district are under investigation. Three hundred men are at work on the State highway authorized by the last New Mexico legislature from Magdalena to Mogollon, which will be known as the northern route. This is not well favored by the operating companies of Mogollon. The latest suggestion, and one that is receiving support, is a proposed road from Lordsburg and Clifton, Arizona, by way of Jackson, New Mexico, into the district. This would open the Gila River country of Arizona into the Mogollon district, and lessen the cost of hay, grain, and oil. Bids are being called by the commissioners of Grant county for the erection of a bridge across the Gila river on the Silver City-Mogollon route. It seems evident that some new route into the Mogollons will be permanently established before long.

In the Lordsburg district the Eighty-Five M. Co. is exploring ground below the 450-ft. level with a Smith-Travers diamond-drill. The machine will also do other work in the district. The company has just started a new electric hoist (Ottumwa), replacing a gasoline engine. The caterpillar tractors for hauling ore from the Eighty-Five mine to Lordsburg have been moved to Safford, Arizona, where they will transport material from the Graham mountains.

The Cobre Negra mine of the Susquehanna Copper Co. at Lordsburg is under option to Faris V. Bush. The mine is developed to 300 ft., and was a large producer of copper carbonate ore above water-level. The ore also contained high gold-content.

Steins is active and several high-grade copper discoveries have caused an influx into the district.——The Johnny Bull Extension has been leased to John Moffitt of El Paso, Texas. ——The Oldan is being profitably worked by William Charles, who is making regular shipments to the El Paso smelter.—— The Panama, Coil, and other mines are being operated with satisfactory results.

New companies to be incorporated in New Mexico within the past two weeks are the Meeker Mining Co. of Pinos Altos (Peterson, Esplane, and others), and the Gold Star Miuing & Milling Co. of Albuquerque.

In the Pinos Altos district Stauber and Wright are successfully operating their mill on complex ore. There is little activity besides this.——The Hardscrabble mine, north of Pinos Altos, is giving excellent returns to J. T. James and associates of Bisbee, Arizona. A recent shipment yielded $1210 per car at El Paso. The ore averaged 40 oz. silver, 17.50% copper, 2% lead, 16.3% iron, and 32% silica. A large amount of money has been spent on the property, and several sections have been put on the market for lease and sale.

At Hanover, the Empire Zinc Co. has commenced work on the new electric power-house to operate the mines and a proposed mill.——Above Hanover, J. W. Bible is preparing the Modoc mine of the Phelps-Dodge company for extensive work. ——The United States Copper Co. is to begin operations at the Philadelphia mine within a short time. The company has had financial troubles, but is now reported to have plenty of money to deepen the main shaft and other work to prove the value of its ground.——J. I. McCullogh and L. M. Stiles, with other El Paso men are reported to have bought the Torpedo mine; and Organ, New Mexico, people are to begin work before long.

The Red River district of Taos county is undergoing extensive development preparatory to the erection of mills. The Buffalo New Mexico Mining Co. is sinking on the Silver King vein at the rate of four feet per day, the present depth being 170 ft.——The Memphis-Red River Mining Co. is down 90 ft. on its vein, where there is two feet of $30 ore.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Chisana

According to T. W. Hocker of Cordova, very little gold was extracted at Chisana this season. There is plenty of water, but little activity. He predicts that the place will be deserted next summer.

A writer in the *Cordova Times* considers that future prospects of the Chisana district are discouraging. From 1913 to August 12, 1915, the James-Nelson claims had yielded $155,715. There was only 250 ft. of ground remaining to be worked on No. 6. The total output of the region for the season will be about $135,000. The James-Nelson people are digging a ditch to sluice the Hamshaw and other ground. Not over 50 people will winter there; many are preparing to leave.

Cordova

Rich copper ore, an extension of the wide shoot at 500 ft. depth in the Bonanza mine, has been opened at 600 ft. The increase in value of the property is estimated at $6,000,000.

Juneau

Suit has been commenced by C. Goldstein, F. B. Hyden, A. D. Nash, and J. Welch against the Alaska Gold Belt Co., alleging that the defendant is not owner of 11 claims in upper Sheep Creek basin.

July returns of the Treadwell group totaled $239,864; details will appear in the next issue.

ARIZONA

Mohave County

The cross-cut at 400 ft. on the Black Eagle section of the Tom Reed mine has passed through 35 ft. of ore. Of this, 14 ft. assays $20, 30 ft. averages $25, and five feet on the hanging wall is worth $7.80 per ton. Drifts have been started on the vein. At 1075 ft. in the Tom Reed the shoot is 225 ft. long on the west, being from 15 to 20 ft. wide, and assaying from $22.50 to $40 per ton.

The United Eastern is shipping 20 tons of ore daily to the Gold Road mill. Development continues to open plenty of good ore.——Work in the Carter has been encouraging, and the shoot should soon be cut at 250 ft.——The Good Ore mine is expected to resume ore production at an early date. A fine shoot has been opened at 530 ft.——At 350 ft. in the Gold Reed incline shaft ore showing free gold was cut. Driving has been started at 375 ft. At Chloride the Payroll gold-silver-lead mine has been unwatered.——The Rainbow, in the same district, is to be examined.

Yavapai County

The Brookshire and Treadwell properties in the Jerome district have been sold for about $1,000,000. The Clift mine is included in the deal. Work is to commence at once.

About 20,000 tons of tailing at the Crown King mill, containing about $150,000 of gold and zinc, has been acquired by M. P. Randolph and D. B. Gemmill. A plant at Superior is to be moved to Crown King to treat the dump.

Fifty tons of 56% copper ore was sent from the United Verde Extension mine to the smelter at Douglas. This shipment will net about $8000.

After being in continuous operation since early in 1886, the old smelter of the United Verde Copper Co. at Jerome was closed on August 21. There was a large gathering present to witness the final run. The new plant at Clarkdale has assumed the duties of the Jerome smelter.

CALIFORNIA

Butte County

It is proposed to construct a dam ¾ mile above Oroville to act as a restraining structure, and so permit the resumption of the hydraulicking in Butte, Yuba, Plumas, and Sierra counties. The silt is to be pumped over the dredge tailing at Oroville, and so make it of value. H. R. Berkey of Sierra county is in Sacramento arranging for the details to be submitted to the Governor. The dam would be 72 ft. high, several hundred feet long, and would cost $1,000,000.

Calaveras County

According to the general manager of the Calaveras Copper Co., S. M. Levy, the mine is in excellent condition. The stope on No. 4 level, south of the Union No. 1 shaft, is in 225 ft. in average grade ore. Plans are being prepared for a new ore-house, increased grinding plant, and a filter-press.

Eldorado County

The two-stamp mill at the O. W. Jackson mine north of Mosquito, Georgetown district, recently yielded gold worth $1600.

Modoc County

The High Grade district has been examined by W. B. Tucker of the State Mining Bureau. He considers the present situation as encouraging.

Nevada County

The Golden Center company has declared a dividend of 4%.

A number of improvements are being made to the surface equipment at the Golden Center mine. A 100-ft. head-frame and new hoist are part of the plant.

Placer County

A dredge costing $75,000 is to be built at Gautier bridge by T. Donahue and others from Seattle. They have secured four miles of Bear river above and below Dog Bar bridge.

Shasta County

The first shipment of ore, five carloads, from the Balaklala copper mine to the Mammoth smelter at Kennett was made on September 1. There are 125 men employed at the mine.

COLORADO

Eagle County

Gold has been found at the head of Brush creek near Thomasville. Prospecting has been active in the district for some time. There is nothing new from the Eagle silver district, where are the Lady Belle and Lady Belle Extension.

Lake County (Leadville)

At the Penrose shaft the water was down to 516 ft. from the collar on August 29.——The zinc-oxide plant is working at capacity. The product contains from 75 to 80% zinc, while the residue has been reduced from 10 to 3% metal.——Local men have a lease on the Reveille and Pilot gold claims in upper California gulch.——A mill is to be erected to treat ores from the Garbut and Ibex No. 3 mines.——The Bwichcogh mill is working well.

Gilpin County

In the Mammoth-Kansas vein on Quartz hill water is standing at the 525-ft. level, and at 600 ft. from the surface in the Ophir shaft. The water is receding slowly. The shaft on this vein is 1450 ft. deep. Some $10 to $20 ore has been opened on the Kansas vein——The Concrete mine is being re-opened. R.

Sayre of Blackhawk has received backing from Denver people. ——In August, lessees at the Frontenac shipped 75 cars of concentrate and four of smelting ore.——The Bates, Ingalls, and other leasing companies are getting good returns.——The Pittsburg, in lower Russell gulch, shipped five lots in August, as follows:

Tons.	Gold per ton, oz.	Silver per ton, oz.	Copper, per cent.
16.3	4.18	6.75	6.25
8.5	4.45	7.39	6.10
12.1	4.72	7.50	6.20
13.1	6.30	7.00	6.20
8.2	9.49	12.00	17.20

Last week the mining property of the Pewabic Consolidated Mines Co., in bankruptcy, was sold to W. F. Gray of Blackhawk, operating the Coeur d'Alene mine on Academy hill, for $30,500. The property is fully equipped and in good order.

Ouray County

During July the Camp Bird mine produced 2668 tons of ore which yielded a profit of $62,000.——On August 28 several old buildings at the Revenue mine, recently acquired by the St. John Mining Co., of London, were destroyed by fire.

Park County

The London mine, worked under lease in charge of C. Aicher, is producing rich gold ore.——There are 60 lessees employed, most of them on good ore. Leadville people are largely interested.

IDAHO

Shoshone County (Coeur d'Alene)

The Hercules mine and mill, closed since May 29 on account of the smelting contract, have resumed work. The Northport smelter is being re-modeled to treat ore and concentrate from the Hercules and Tamarack & Custer mines controlled by the Days.

The Coeur d'Alene Antimony Mining Co., which has acquired the Antimony mine, on Pine creek, near Kellogg, has men at work re-timbering the shaft, preparatory to unwatering the property, according to W. H. Bourke of Spokane, fiscal agent for the corporation. Pumping and hoisting machinery have been delivered at the mine, and probably will be installed in a few days. A previous operator produced a good deal of high-grade ore.

Control of the Interstate-Callahan Consolidated Mines Co. is the subject of a suit recently commenced. Two sets of directors and officers were elected at Duluth, Minnesota, three weeks ago, and the dispute, which is somewhat complex, is between them. The Idaho court has appointed Eugene R. Day to act as receiver and manager to protect the shareholders' interests.

The Carbonate Hill Mining Co. has bonded its property to the Butte & Superior company for $587,630. The ore-shoot recently cut has been opened for 100 feet.

MISSOURI

Jasper County

North of Miami, Oklahoma, the Picher Lead Co. is sinking five shafts, one of which has opened high-grade zinc-lead ore at 265 ft. Three 300-ton mills and one of 500-ton capacity are to be erected at the shafts.

MONTANA

Missoula County

(Special Correspondence.)—The Martina Gold Mining Co. has started its 40-ton cyanide-plant treating accumulated tailing from the stamp-mill. The company expects to operate until the beginning of winter and resume in the spring.

Nine Mile District, Martina, August 31.

Silverbow County

The Butte-Duluth Mining Co. is in financial difficulties, and is in the hands of a receiver appointed by the State court. A number of employees are owed a total of $4098, and ask for some relief. The company's engineers state that a great deal of money has been spent on equipment, and the company is now able to treat ore in the re-arranged plant.

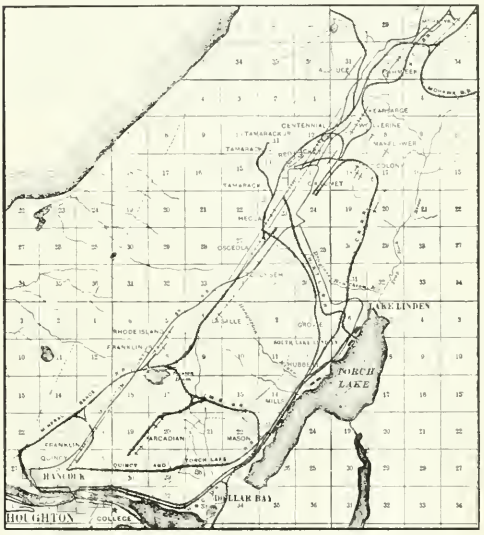
There are over 13,000 men employed at the Butte mines at present. The average wage is $3.75 per day, making a large total monthly distribution.

MICHIGAN

The Copper Country

During July the Mineral Range railroad hauled over 500,000 tons of ore from 13 mines to the mills, also mass copper direct to smelters. The Calumet & Hecla company has a large interest in this line.

In the White Pine district there are 17 diamond-drills search-



PART OF THE COPPER COUNTRY, SHOWING MINES AND RAILROAD SYSTEMS.

ing for the Nonesuch and White Pine lodes, and further proving the White Pine Extension, Onondaga, and other mines.

A second bonus of 5% was paid last week to employees of the Mohawk and Wolverine companies. Monthly bonuses will be distributed as long as copper sells at the present price.

NEVADA

Esmeralda County

The estimated production of the Goldfield Consolidated in August is as follows: Ore mined, 32,100 tons; gross extraction, $267,500; operating expense, $160,500; and net realization, $107,000.

Humboldt County

The Darby 10-stamp mill and cyanide-plant at Mazuma resumed work last week. The plant is being operated under lease by the Delaware Mining Co., which recently purchased the Delaware mine above Vernon. The ore now being treated comes from the dump, where there is 1400 tons averaging about $25 per ton. The haul from the mine to the mill is 4½ miles. H. H. Hunter, Sr., of Lovelock is responsible for the revival at these two centres.

Mineral County

Virginia City men are developing a molybdenite deposit near

Sweetwater. A lode 2 to 6 ft. wide is said to average 17 to 20% metal. Experiments are under way on the local treatment of the ore.

NYE COUNTY

Five companies and several lessees at Tonopah last week produced 9907 tons of ore worth $204,286.——There has been an improvement at 800 ft. in the Red Plume claim of the Tonopah company.——The Victor mine of the Extension company has been drained; work was resumed at 1540 ft., and 5 ft. of ore is showing in the cross-cut.——A station has been cut out at 1330 ft. in the Midway.——Fifteen sets of lessees at the Montana are employing 47 men.

UTAH

SALT LAKE COUNTY

Companies and lessees at the Little and Big Cottonwood districts continue busy and optimistic. Twenty-five men are working at the Alta Consolidated. Some rich copper ore is being opened.——The Emma copper mine is shipping two cars of ore; 26 men are employed.——The Columbus Extension has arranged for a market for its zinc ore. The last carload returned $18 per ton net.——A geological survey is to be made of the Alta Cottonwood property. The main adit is in 850 ft. toward the quartz-limestone contact.

WASHINGTON

SPOKANE COUNTY

During August the Spokane Stock Exchange business totaled 1,283,244 shares of Washington, Idaho, and British Columbia companies, valued at $200,063, a record.

STEVENS COUNTY

A contract has been let for a large quantity of lumber for the Northport smelter. While excavating in the old plant several thousand dollars worth of copper matte was unearthed.

TOOELE COUNTY

Work it to be resumed at the Le Vine-Pratt-Allen properties in Pine canyon. The adit is in 2500 ft., and is to be driven 15,600 ft. to act as a mining, transportation, and drainage tunnel for several mines in the Bingham district.

CANADA

ONTARIO

The old Wright lead-silver mine, on the Quebec side of Lake Temiskaming, is being unwatered by the Canadian Mining & Finance Co. The property has been worked at irregular intervals for 200 years.

At 200 ft. in the Tough-Oakes mine, at Kirkland Lake, No. 3 vein has been cut, showing 18 in. of ore worth $200 per ton. At 100 ft. depth the shoot was broken up. At the bottom of the winze, down below 300 ft., there is also 18 in. of $600 ore.

YUKON

On August 17 Dawson appropriately celebrated the nineteenth anniversary of the discovery of gold in the Klondike. The *Dawson Daily News* published a special edition. From 1885 to 1915, inclusive, the current year being estimated, the total output is $185,000,000. (Alaska has yielded $265,000,000, including 1915.) A total of 6236 placer claims were in good standing at the end of March 1915. Of these, 5350 were in the Dawson district, 456 in Sixtymile, 245 in Duncan, 53 in Whitehorse, and 132 in Kluane. Quartz claims aggregated 910, of which 466 were at Dawson, 199 at Duncan, 85 at Whitehorse, 8 at Kluane, and 52 at Conrad. To August, there were 162 claims crown granted.

MEXICO

HIDALGO

During July the Santa Gertrudis mine yielded a profit of $2300 from 6500 tons of ore. On account of shortage of lime, treatment was suspended from July 12 to early in August.

PERSONAL

LEON J. PEPPERBERG is in Texas.

R. M. RAYMOND has gone to El Paso.

KARL EILERS is at the Fairmont hotel.

P. E. O. CARR is at San Antonio, Texas.

GEORGE OTIS SMITH is at the Stewart hotel.

F. LYNWOOD GARRISON is at the Colonial hotel.

H. L. SWAIN, of Baldwin & Swain, is here from Mexico City.

O. C. RALSTON, of the Bureau of Mines, Salt Lake City, is here.

W. E. SIMPSON and G. A. DENNY have gone to London from Mexico.

HARRY OAKES, of Kirkland Lake, Ontario, is visiting the Exposition.

THOMAS H. TULLOCH will be at Superior, Arizona, for about two months.

L. C. HARRINGTON, of the University of North Dakota, is at Ketchikan, Alaska.

W. MOTHERWELL has gone to Colorado Springs, and expects to remain there for several months.

F. SOMMER SCHMIDT passed through San Francisco on his way from Latouche island, Alaska, to Salt Lake City.

E. K. SOPER, recently in the University of Minnesota, has been appointed Professor of Mining in the University of Idaho.

F. C. FRENCH, who has been for the past three years with the Butte & Superior Copper Co., at Butte, has returned to Salt Lake City.

P. R. BRADLEY, manager of the Alaska Treadwell, and STANLY EASTON, manager of the Bunker Hill & Sullivan mine, are expected to attend the Engineering Congress.

FRANK L. SIZER has retired as superintendent for the Mascot Copper Co., Arizona, but will continue to act in the capacity of consulting engineer to the company, with an office in San Francisco.

Among those who will arrive on the special train of the engineering societies from New York, due on the 15th inst., will be W. L. SAUNDERS, BRADLEY STOUGHTON, JOSEPH B. TYRRELL, R. V. NORRIS, MARTIN L. GRIFFIN, EDWIN LUDLOW, EUGENIO AGUILERA, J. B. HARPER, ROBERT H. RICHARDS, BURR A. ROBINSON, T. H. O'BRIEN, R. A. WALTER, L. D. BURLINGAME, GEORGE S. PAGE, GUILLIAEM AERTSEN, S. M. PITMAN, WALTER HARVEY WEED, C. G. MEMMINGER, SIDNEY J. JENNINGS, and C. E. TURNER.

On the train from New Orleans will be NELSON B. GATCH, W. ROGERS WADE, E. NORRIS HOBART, R. B. STANFORD, JOHN H. BERNHARD, and B. H. CASE.

Schools and Societies

The College of Mines and Engineering of the UNIVERSITY OF ARIZONA at Tucson will commence a 10 weeks' course for miners on October 4. It will be thoroughly practical.

Invitations have been sent by the AMERICAN ASSOCIATION OF ENGINEERS to the engineering departments of all the principal railroads, corporations, and firms in the city of Chicago to attend a booster dinner to be held at the Hotel LaSalle on September 14. F. H. Newell, head of the department of civil engineering at the University of Illinois, and who until recently was director of the U. S. Reclamation Service, will speak at this dinner on the 'Needs of Organization Among Engineers.' The aims of the Association is to raise the standard of ethics of the engineering profession, and to promote the economic and social welfare of engineers. A 30% increase in membership, drawn from engineering professions in all parts of the United States, has been registered by this organization during the past two weeks. A national convention is to be held at Chicago on December 10 and 11.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, September 9.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	5.15— 6.10
Quicksilver (per flask)	$95
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	30

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, September 9.—The entire metal market is lifeless, and quotations are merely nominal.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Sept.	2	July 28	18.62
"	3	Aug. 4	18.27
"	4	" 11	17.94
"	5 Sunday	" 18	16.89
"	6 Holiday	" 25	16.27
"	7	Sept. 1	17.83
"	8	" 8	17.62

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended August 21 totaled 9,566,132 lb., worth $1,742,659. Of this, France secured 6,770,690; England, 1,413,524; Japan, 720,000; Italy, 249,587; Russia, 225,223; and Spain 128,995 lb. Imports of all kinds amounted to 4,045,285 lb., worth $691,090. England sent 979,000; Peru, 914,813; Chile, 658,090; Portuguese Africa (probably in transit), 586,550; Japan, 473,352; and Canada, 431,100 pounds.

The first shipment of copper from Chuquicamata, Chile, arrived at Savannah, Georgia, last week. It consisted of 16,878 bars weighing 70 lb. each, or a total of 1,181,460 pounds.

July outputs were as follows: Chino, 6,650,429; Nevada Consolidated, 6,292,413; Ray, 4,471,400; and Utah Copper, 14,641,000 lb. August returns were: Anaconda, 22,800,000; Old Dominion, 2,830,000; and Shannon, 950,000 pounds.

The Michigan copper country produced 26,000,000 lb. in August.

Dividends declared are: Calumet & Hecla, $15 per share; Calumet & Arizona, $1 per share; Guggenheim Exploration, 4%; Superior & Pittsburg, 38c. per share; Old Dominion, $1.50 per share; and Wolverine, $5 per share.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept.	2	July 28	47.29
"	3	Aug. 4	47.08
"	4	" 11	47.27
"	5 Sunday	" 18	47.33
"	6 Holiday	" 25	47.08
"	7	Sept. 1	46.77
"	8	" 8	48.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

With the improvement in exchange between New York and London there has been a stronger silver market, but the upward movement is about finished. On September 4 about 250,000 oz. was sent from San Francisco to China. During the third week of August China was a buyer of metal, but the Indian Bazaars maintained a temporizing policy, sending at intervals buying limits too low to tempt sellers.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug.	11	Aug. 25	95.00
"	18	Sept. 1	95.00
		" 8	95.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	52.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Sept.	2	July 28	5.50
"	3	Aug. 4	5.12
"	4	" 11	4.79
"	5 Sunday	" 18	4.44
"	6 Holiday	" 25	4.49
"	7	Sept. 1	4.87
"	8	" 8	4.90

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.3	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Sept.	2	July 28	18.96
"	3	Aug. 4	17.79
"	4	" 11	15.12
"	5 Sunday	" 18	12.21
"	6 Holiday	" 25	11.96
"	7	Sept. 1	15.75
"	8	" 8	14.77

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

It is expected that the American Zinc Co., which had a bad year in 1914, will earn $5,000,000 net during the current year. In July and August the profit was $2,000,000.

According to a consular report a firm at Hongkong is buying a good deal of spelter; previous requirements came from Germany.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	30.20	34.37
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On September 8 tin was quiet at 33 to 33.50 cents. With a capital of $100,000 the Standard Smelting Co. of Pittsburg has been organized by H. S. Glenn, C. E. Glenn, C. R. Buchheir, and R. S. Wile. Two Wile electric-furnaces are being erected in the old works of the R. E. Nuttall Co. to smelt Bolivian 'barrilla' (tin concentrate). The initial capacity is 6 tons of tin daily.

ANTIMONY

The market has not gained in activity or strength. The quotation for Chinese antimony has remained at 28c., duty paid. For future delivery sellers offer about 27c., in bond.

ALUMINUM

Quotations have advanced. Spot metal, 98 to 99% pure, in ton lots, is quoted at 36 to 37c., New York. For small lots excessive premiums are asked. Spot is scarce, and automobile makers are eager to get the metal. The scarcity of brass rods has caused some makers of shrapnel fuse-timers to use aluminum for certain of the parts. Tobin bronze and phosphor bronze have also been used.

Eastern Metal Market

New York, September 3.

The excited activity in copper, lead, and zinc, which developed full force on August 25 and 26, came to an end in the last days of the month. All three metals are now quiet. They show indications of softening, but so far the advances that accompanied the movement have been fairly well held. Copper producers still quote 18c. All the metals are affected adversely by the low rate of sterling exchange, which, on September 1, touched $4.50, closing at $4.55. Spelter has been uncertain, buyers withdrawing from the market with the advent of September. In three days, the A. S. & R. Co. advanced its New York lead quotation $8 per ton, making the quotation 4.90c. per lb. Second-hands are showing some disposition to take profits, but 4.90c. is still general. August deliveries of tin were large—4500 tons. Tin has been dull and prices have declined. Sellers have not been living up to the requirements of Great Britain, and the Tin Committee of the New York Metal Exchange has requested closer conformance with them, stating that infractions may jeopardize the entire arrangement under which tin is imported. Antimony remains inactive and weak. Aluminum has advanced.

The steel industry continues to prosper under the stimulus of sustained war business. Practically the entire open-hearth steel capacity of the country is under contract for the remainder of the year, and the mills are avoiding, so far as they can, contracts running into next year. There is a growing tendency on the part of all who have taken war business to say less about it; one reason for this attitude being the growing unrest of labor. Demands for the 8-hr. day and higher wages are appearing on all sides, and in most cases are being acceded to. Pig-iron continues to advance, and particularly high prices are being paid for steel-making iron. Next to the munition manufacturers, the automobile-makers appear to be the busiest class in the country.

COPPER

Three features stand out in the copper market: first, the activity that was at its height on August 25 and 26, ended on the 28th; second, while producers are still adhering to 18c., 30 days, delivered, second-hands will sell freely at substantial concessions, certainly at 17.75c., cash, New York, and probably as low as 17.50c; third, the purchasing of copper by Great Britain is seriously imperiled by the demoralization in sterling exchange which, on September 1, dropped to $4.50, although it later recovered and closed at $4.55. At $4.50 the decline represented a loss of practically 36c. from $4.8665, which is the normal equivalent of the pound sterling. [The rate has been erratic, mounting on September 3 to $4.70, then dropping to $4.64.]

Last week reference was made to the indications of activity in copper which appeared on August 24th. On the 26th the trade was particularly excited, and for a time a runaway market was threatened. A large business was done, especially at the outset of the flurry before buyers had time to think things over. When they did stop to consider, it occurred to them that the advance of 2c. in the course of a few hours was not a natural procedure, and they became more conservative. A producer is authority for the statement that American consumers led the way in the movement, and that they were followed by purchasers on foreign account. One statement made is to the effect that the rapid advance was a device to stir English buyers to activity. However that may be, it is certain that the heaviest purchasers were war contractors, here or abroad. As ammunition plants get into full swing, and more contracts are being placed steadily, more and more copper will be needed; but it remains to be seen how far this demand will compensate for the falling off in ordinary consumption. In the excitement of last week, enough Lake changed hands to establish its level at 18c. For months its quotation has been almost entirely nominal. The August exports of copper totaled only 16,289 tons. Since January 1, the exports have been 170,524 tons, against 273,365 tons, in the same period of 1914, a falling off of 102,841 tons. It should be remembered, however, that the exportation of copper contained in finished products has greatly increased. The quotations for electrolytic September 3 were 17.50 to 17.75 cents.

ZINC

At the opening of the week ended September 4 zinc was quoted at 16.50 to 17c., but subsequently the market weakened. Buyers withdrew until the situation was nominal; apparently in sympathy with the quiet conditions in the copper market. Between August 26 and 30 a large business was done, and on some sides 20c. spelter was again predicted. It is curious that during the excitement, and after it had subsided, spot zinc was exceedingly hard to procure. While the quotation at New York was about 16c., for prompt delivery, which really meant September delivery, 15.50c. was called a fair average price for last quarter delivery. By September 3, the market stood at 15c. New York, for prompt, while futures ranged from 13.50 to 14.50c. A characteristic of the present market is its uncertainty, and the rapidity with which purchasers drop out of sight before they have filled their supposed requirements. All concerned seem to be very sensitive. This is largely due to statements recently circulated with the unmasked purpose of depressing the market. Certain dealers have gone to unusual pains to show that over-production was impending, although it would seem to be to their advantage to pursue a different policy. On the other hand, statements are being made now that production will not be augmented as much as was predicted. The August exports totaled 3839 tons.

LEAD

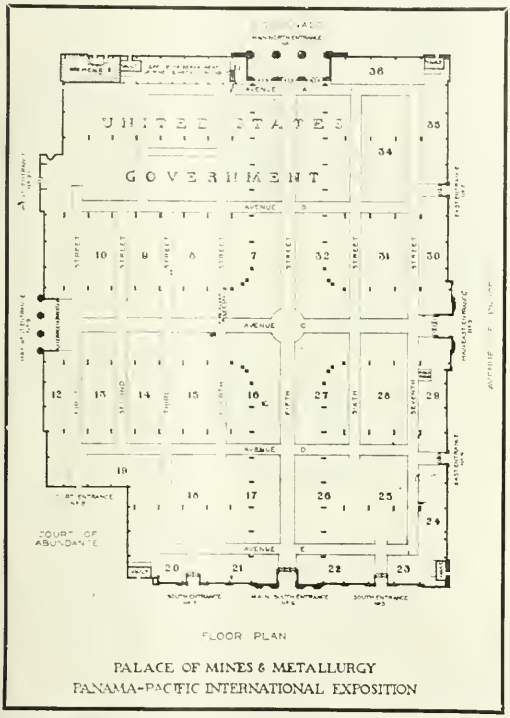
On August 26 the A. S. & R. Co. advanced its New York quotation for 50-ton lots, $2 per ton or to 4.60c. per lb., and on the 27th it made a further advance of $4 per ton or to 4.90c. per lb, a total advance in three days of $8. As mentioned a week ago, the advance of $2 per ton, to 4.60c. (August 25) brought about a stampede on the part of buyers, and it was not checked until 4.90c. was quoted. Second-hands withdrew the low prices they had been quoting and followed the lead of the big interest. The fact that many consumers were pinched in the last bulge unquestionably restrained some of them from action on the new advance, but the fact remains that a large quantity of lead changed hands. After August 28 the market became quieter, and at least some of the second-hands then got busy taking profits on metal they had bought at around 4.50c. As a rule, however, the market, though showing some weakness in the direction alluded to, held fairly firm, and 4.90c. New York, was the general quotation on September 3. August exports totaled 2508 tons. Live war inquiries are still pending.

TIN

Deliveries into consumption in August were large, amounting to 4500 tons. Arrivals at Atlantic ports totaled 4936 tons, and those at Pacific ports destined for the East, 1100 tons. In general, business in August was slow, and prices declined. The total arrivals since January 1, 1915 are figured at 31,375 tons, against 29,900 tons in the same period of 1914. In stocks and landing on August 31 was 2527 tons, and there was afloat on that day 6170 tons. The total visible world supply August 31, 1915, was 15,127 tons, against 16,084 tons a month previous, and 14,452 tons, August 31, 1914. In the past week business has been slow, and the quotation for spot dropped on August 31 to 33.50c. New York. The average price in August was 34.37c. Early this week the market was practically at a standstill.

Engineering Exhibits at the Exposition

The following is not given as a complete directory of exhibits; it is a suggestion for the visiting engineer whose time is limited, and represents the more notable prog-



PALACE OF MINES & METALLURGY
PANAMA-PACIFIC INTERNATIONAL EXPOSITION

ress in the manufacture and design of engineering apparatus and is worthy of careful inspection. Reference to the accompanying maps of the buildings will show the location of each exhibit.

Palace of Mines and Metallurgy

ASSAY SUPPLIES

The Braun Corporation
U. S. Bureau Exhibit
See advertising section.....page 57

Ainsworth & Sons
U. S. Bureau Exhibit
See advertising section.....page 65

BALANCES

Ainsworth & Sons
U. S. Bureau Exhibit
See advertising section.....page 65

The Braun Corporation
U. S. Bureau Exhibit
See advertising section.....page 57

Braun-Knecht-Heimann Co.
U. S. Bureau Exhibit
See advertising section.....pages 57 and 65

CHEMICALS

Roessler & Hasslacher Chemical Co.
7th St., Aves A and B
See advertising section.....page 65

Braun-Knecht-Heimann Co.
U. S. Bureau Exhibit
See advertising section.....pages 57 and 65

The Braun Corporation
U. S. Bureau Exhibit
See advertising section.....page 57

COMPRESSORS

General Machinery & Supply Co.
Mine Collective Exhibit, Ave. B and 5th St.

CONCENTRATORS

Deister Concentrator Co.
(See Miscellaneous)

Senn Concentrator Co.
Ave. A and 7th St.
See advertising section.....page 10

Hendrie & Bolthoff Mfg. & Supply Co.
Mine Collective Exhibit, Ave. B and 5th St.
See advertising section.....page 2
(Also see Miscellaneous)

CYANIDING MACHINERY

Dorr Cyanide Machinery Co.
U. S. Bureau Exhibit
See advertising section.....page 29

Merrill Metallurgical Co.
U. S. Bureau Exhibit
See advertising section.....page 32

Pacific Tank & Pipe Co.
Ave. A and 7th St.
See advertising section.....page 72

Trent Engineering Co., L. C.
7th St., Aves. A and B
See advertising section.....page 15

CYANIDE

The Braun Corporation
U. S. Bureau Exhibit
See advertising section.....page 57

Braun-Knecht-Heimann Co.
U. S. Bureau Exhibit
See advertising section.....pages 57 and 65

Roessler & Hasslacher Chemical Co.
7th St., Aves. A and B
See advertising section.....page 65

DREDGES

Yuba Construction Co., The
Model Gold Dredge
See advertising section.....page 42

FILTERS

Merrill Metallurgical Co.
U. S. Bureau Exhibit
See advertising section.....page 32

Oliver Continuous Filter Co.
Ave. A and 6th St.
See advertising section.....pages 12 and 13

HOISTS

Hendrie & Bolthoff Mfg. & Supply Co.
Mine Collective Exhibit, Ave. B and 5th St.
See advertising section.....page 2

MACHINE TOOLS

(See Palace of Machinery)

MINE EQUIPMENT

Ingersoll-Rand Co.
The Mine
See advertising section.....page 36

Goodyear Tire & Rubber Co.
The Mine

Hendy Iron Works, Joshua
The Mine
See advertising section.....pages 3 and 4

Sullivan Machinery Co.
The Mine
See advertising section.....page 35

McKiernan-Terry Drill Co.
U. S. Steel Corp. collective exhibit
See advertising section.....page 71

ORE GRINDING MACHINERY

Hardinge Conical Mill Co.
U. S. Bureau Exhibit
See advertising section.....pages 6 and 7

PIPE

National Tube Co.
U. S. Steel Corp. collective exhibit
See advertising section.....page 71

Pacific Tank & Pipe Co.
6th St., Aves. A and B
See advertising section.....page 72

PUMPS

Jackson Iron Works, Byron
The Mine, collective exhibit, Ave. B and 5th St.
See advertising section.....page 26
(Also see Palace of Machinery)

RESCUE APPARATUS

Siebe, Gorman & Co., Ltd.
4th St. and Ave. A
See advertising section.....page 36

ROASTING FURNACES

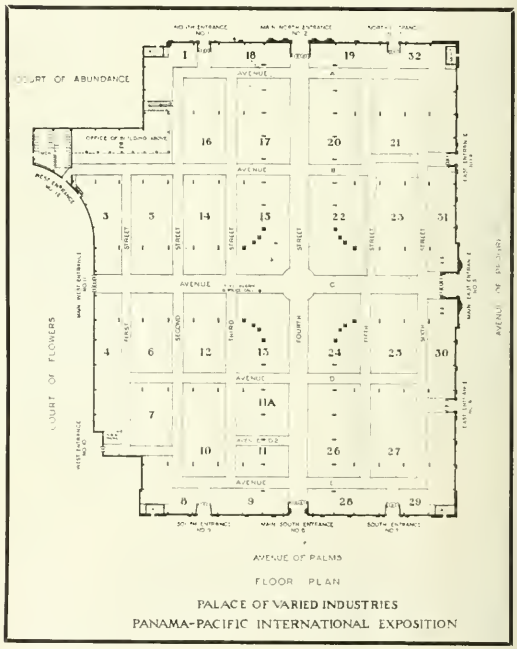
Wedge Mechanical Furnace Co.
U. S. Bureau Exhibit
See advertising section.....page 31

SCREENS

Dodge Mfg. Co.
U. S. Bureau Exhibit
See advertising section.....page 60

STAMP-MILLS

Straub Mfg. Co.
Ave. C and 6th St.
See advertising section.....page 17



STEAM-SHOVELS

Bucyrus Company
Moving pictures of steam-shovel
The Mine

TANKS

Redwood Manufacturers Co.,
Tanks in the L. C. Trent Engineering Co.'s exhibit are made by this firm.
See advertising section.....page 25

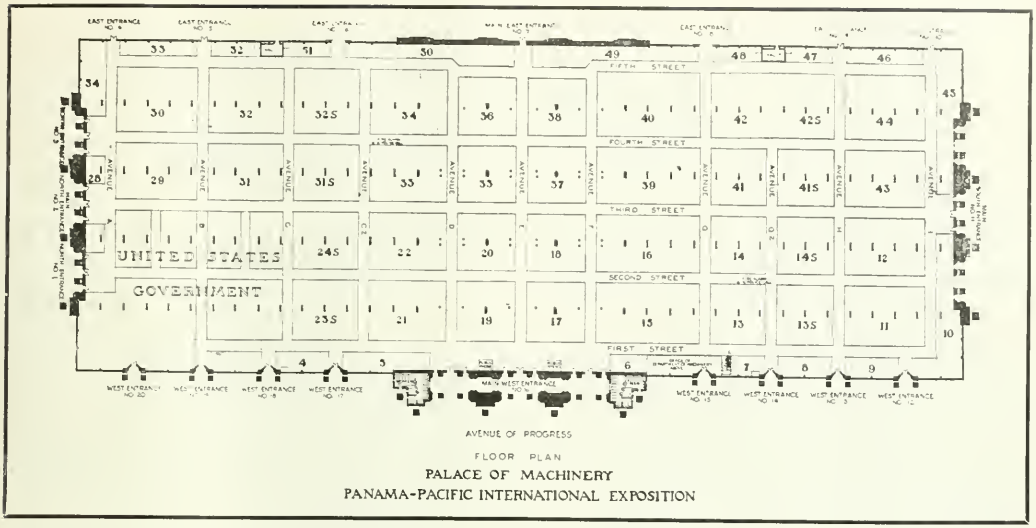
Pacific Tank & Pipe Co.
6th St. bet. Ave. A and B
See advertising section.....page 72

TELEPHONES

Western Electric Co.
The Mine

TRAMWAYS

American Steel & Wire Co.
U. S. Steel Corp. collective exhibit
See advertising section.....page 57



FLOOR PLAN
PALACE OF MACHINERY
PANAMA-PACIFIC INTERNATIONAL EXPOSITION

WIRE AND CABLE

American Steel & Wire Co.
U. S. Steel Corp. collective exhibit
See advertising section.....page 57

Palace of Machinery

BELTING

Schieren & Co., Chas. A.
2nd St. and Ave. G
See advertising section.....page 5

CENTRIFUGAL PUMPS

Krogh Manufacturing Co.
3rd St., Aves. H and I
See advertising section.....page 22

Pelton Water Wheel Co.
4th and 5th Sts., Ave. F
See advertising section.....page 21

CONCRETE MIXER

Power & Mining Machinery Co.
4th St. and Ave. A
See advertising section.....page 62

CONVEYING MACHINERY

Dodge Mfg. Co.
5th St. and Ave. H
See advertising section.....page 60

Meese & Gottfried Co.
2nd and 3rd Sts., Aves. H and I
See Back Cover

ELEVATING MACHINERY

Dodge Mfg. Co.
5th St. and Ave. H
See advertising section.....page 60

Meese & Gottfried Co.
2nd and 3rd Sts., Aves. H and I
See Back Cover

ENGINES

Busch-Sulzer Bros.-Diesel Engine Co.
3rd St., Aves. D and E
See advertising section.....page 34

Flory Mfg. Co.
4th St. and Ave. D
See advertising section.....page 16

Harron, Rickard & McCone
4th and 5th Sts., Aves. G and H
See advertising section.....page 27

FILTER PRESSES

Kelly Filter Press Co.
U. S. Bureau Exhibit
See advertising section.....page 58

HOISTS

Flory Mfg. Co.
4th St. and Ave. D
See advertising section.....page 16

LUBRICATORS

Lunkenheimer Co., The
1st St. and Ave. 62
See advertising section.....page 71

MACHINE TOOLS

Harron, Rickard & McCone
4th and 5th Sts., Aves. G and H
See advertising section.....page 27

MINE EQUIPMENT

Harron, Rickard & McCone
4th and 5th Sts., Aves. G and H
See advertising section.....page 27

PIPE

Redwood Manufacturers Co.
5th St. and Ave. D
See advertising section.....page 25

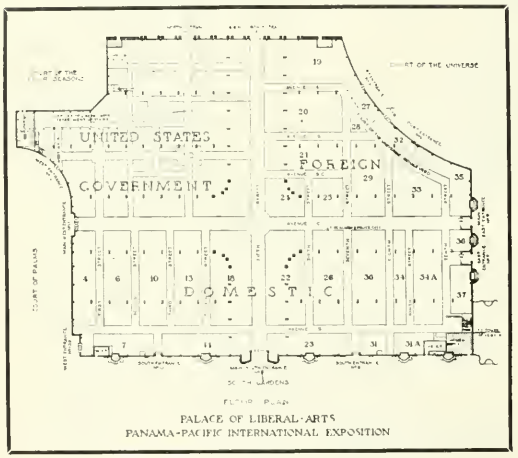
POWER TRANSMISSION

Dodge Mfg. Co.
5th St. and Ave. H
See advertising section.....page 60

Meese & Gottfried Co.
2nd and 3rd Sts., Aves. H and I
See Back Cover

Schieren & Co., Chas. A.
2nd St. and Ave. G
See advertising section.....page 5

Westinghouse Electric Mfg. Co.
3rd St., Aves. C2 and D
Collective exhibit of various electrical devices, including prime movers.



PALACE OF LIBERAL ARTS
PANAMA-PACIFIC INTERNATIONAL EXPOSITION

PUMPS

American Well Works
1st St., Aves. G and G2
See advertising section.....page 62

Harron, Rickard & McCone
4th and 5th Sts., Aves. G and H
See advertising section.....page 27

Krogh Mfg. Co.
3rd St., Aves. H and I
See advertising section.....page 22

Pelton Water Wheel Co.
4th and 5th Sts., Ave. F
See advertising section.....page 21

TANKS

Redwood Manufacturers Co.
5th St. and Ave. D
See advertising section.....page 25

TURBINES

Pelton Water Wheel Co.
4th and 5th Sts., Ave. F
See advertising section.....page 21

VALVES

Lunkenheimer Co., The
1st St. and Ave. G2
See advertising section.....page 71

WATER HANDLING DEVICES

Harron, Rickard & McCone
4th and 5th Sts., Aves. G and H
See advertising section.....page 27

WATER WHEELS

Pelton Water Wheel Co.
4th and 5th Sts., Ave. F
See advertising section.....page 21

Miscellaneous

DEISTER CONCENTRATOR CO., THE

California State Building
Department of Mines
Concentrating Table
See advertising section.....page 18

KEUFFEL & ESSER CO.

Palace of Liberal Arts
5th St., Aves. C and D
Engineering Instruments
See advertising section.....page 14

GENERAL ELECTRIC CO.

Transportation Building
Mining Locomotives
Ave. C, 1st St., 2nd St., and Court of Honor Blvd.
See advertising section.....page 40

Transportation Building
Electric Hoist Equipment
Ave. C, 1st St., 2nd St., and Court of Honor Blvd.

Manufacturers Building
Motors
7th St., 8th St., East Walk, and Ave. B

Manufacturers Building
Motor Generator Sets
7th St., 8th St., East Walk, and Ave. B
Also driving exhibits and concessions, all over Exposition

LIETZ CO., THE A.

Palace of Liberal Arts
Ave. D and 6th St.
Instruments

WESTERN ELECTRIC CO.

Palace of Manufacturers
8th St., Aves. B and C
Electric Wires and Cables

WESTINGHOUSE ELEC. & MFG. CO.

Transportation Palace
Under the Dome
Electrical Precision Instruments

YUBA CONSTRUCTION CO., THE

California State Building
Department of Mines
Model Gold Dredge
See advertising section.....page 42

EDITORIAL

T. A. RICKARD - Editor

LOOK at page 427, on which an urgent appeal is made to you.

SINCE July 28, 1914, twenty-one declarations of war have been made. None of them has been cancelled as yet.

JOHN D. RYAN confirms the opinion expressed in these columns several weeks ago. He is reported as saying: "After the war is over there will probably be a temporary dull period followed by the best copper market the world has ever seen."

GOLD is absorbed by the United States to an extent rarely recognized. The whole of the domestic production, averaging $87,500,000 per annum for 18 years, plus imports of $12,500,000 per annum, making just $100,000,000, is absorbed in this country.

WHETHER New York is to be the money centre of the world depends not on the fall of sterling exchange, but on the restoration of it, in consequence of the ability of New York to meet the financial requirements of an abnormal epoch in international relations.

VISITORS to the Panama-Pacific Exposition are urged to see the U. S. Steel Corporation's motion-pictures, which are on view from 11 a.m. to 6 p.m. This cinema display illustrates drilling for iron ore, exploratory work, mining, transport in various forms, blast-furnaces, pipe-making, steel-shaping, and the manufacture of cement from slag.

SPEAKING of institutes and congresses, we note that a Mining Conference is to be held at Seoul, in Korea, on September 25 and 26, under the auspices of the chief of the Mining Bureau of Chosen; it is also proposed to form a Korean Mining Institute, all of which has been done on the initiative of Messrs. A. H. Collbran, E. W. Mills, and Arthur R. Weigall.

FROM our Platteville correspondent, who regularly covers this zinc-producing region of Wisconsin, we learn that the product now being made is high-grade, there being no market for concentrate containing under 58% zinc, which is in strong contrast with the low-grade material shipped prior to the recent rise in spelter and the more exacting demands of the smelters. A complete transformation has been made in treatment during a few months, showing what can be done when circumstances force a change, otherwise Platteville would be unable to sell any of its product. Among the new methods of separating zinc is the Campbell process, in which the ore is roasted before being exposed on a magnetic field, whereby the iron is removed. This process is being used at Linden, Wisconsin, with satisfactory results.

THAT big spelter production of which much has been predicted recently is being whittled down from day to day. The United States Zinc Co. reports that it is not the intention to increase the capacity of its plants. The United States Steel Corporation announces that the only zinc plant under construction on its account is the one at Donora, Pennsylvania, where 10,000 retorts will be erected. A retort produces about 4 tons of zinc per annum.

SAFETY-FIRST is being vigorously pushed at Butte. A motion-picture play has been acted on the 1600, 1700, and 2000-ft. levels of the Tramway mine and is now being shown in a local theatre. These are said to be the first moving pictures taken so deeply underground. A contest was held in Butte on September 6 between First-Aid and Mine-Rescue teams; the winning team will represent the city at the first national contest, which is to be held in San Francisco on the Exposition grounds, September 23 and 24.

CHEAP LABOR to the tyro may suggest cheap production; but the student of labor conditions and industrial history has learned that cheap labor most often indicates a high cost of production. This is well shown by shop records, where when the machinists averaged $3.28 per diem the cost per piece was $1.17, while when the average earnings were $5.74 the cost per piece dropped to 54 cents. Records of a large manufacturer having factories in Europe and America showed that for a cost of 100 in the United States the cost in Sweden was 102, in Germany 106, in France 111, and in Russia it was 133.

KOWKASH is the name of a new goldfield in Canada. Our Toronto correspondent gives particulars. The locality of the latest 'rush' or 'stampede' is in Ontario, and on the National Transcontinental railroad. The name is a merciful abbreviation of Kowawkagashkama, the name of the river near which the first discovery was made. The gold-seekers are flocking to the scene, not in prairie-schooners, on horseback, or on foot, as in former occasions of the sort, but in special trains, with Pullman dining-cars and all the comforts of home—if not better. Our correspondent quotes Mr. J. B. Tyrrell as being well impressed by the samples shown in Toronto. We

know that he has backed his opinion by going to Kowkash, so that we shall miss him at the Engineering Congress, for which he had been booked.

ONE of the expectations falsified by the War was the idea of our stock of gold becoming exhausted by shipment across the Atlantic; on the contrary, the danger lies in the opposite direction. By a fortunate coincidence our crops of wheat and cotton were both abnormally large last autumn, being 930 million bushels of the one and 17 million bales of the other, so that an amazing international balance of credit was created by the end of June this year, the sum being $1,094,000,000. Other expectations, we are thankful to say, have not been fulfilled, such as the ruin of our copper industry and the swamping of our exchanges by the liquidation of American securities from Europe. But one consequence, the necessity for big loans to our customers across the water, was not foreseen, and must be faced now. Upon it will depend the trend of human history.

SECRETARY DANIELS has a splendid advisory board for the Navy Department. The national engineering societies have nominated representative experts to contribute their inventive genius to the service of the country, under the chairmanship of Mr. Thomas A. Edison. We note with pleasure that Mr. William L. Saunders, president, and Mr. Benjamin B. Thayer, ex-president of the American Institute of Mining Engineers, have been selected as representatives of mining and metallurgy; also Messrs. Joseph W. Richards and Lawrence Addicks as exponents of electro-chemical engineering; Messrs. Peter Cooper Hewitt and Thomas Robbins as nominees of the Inventors Guild; and a number of others of equal distinction but not so well known to us or to our readers. The idea of mobilizing the talent of the country for defensive purposes is a bit of sublime common sense greatly to the credit of the Federal Administration.

WHEN we wrote on the subject of directors and speculation, we were aware that directors do speculate and do make a wrong use of information that comes to them in their official capacity. We could have quoted chapter and verse for speculations in mining shares that ran perilously near the line dividing unfairness from criminality. But we confess the bold operations of the Rock Island wreckers exceed anything in our experience. These recreants wasted $20,000,000 in unwise and improper deals "outside the proper sphere in which stockholders had a right to suppose their moneys were invested." Of this $1,000,000 was voted to the officers in the form of gratuities. The *Nation*, from which we take the above facts, states that "the crux of the whole thing lies in the attitude of directors like Daniel G. Reid, who testified that he burns his books at the end of every month, and so could not explain his profits from the various transactions in which he as a director took part." In many countries such burning of records is a criminal offense, and it should be criminal in this supposedly enlightened land. We believe that in Russia a merchant is obliged to keep his books for ten years. Such atrocities as that of Mr. Reid go far to justify the fierce attacks made on capital by demagogues like Mr. Frank P. Walsh, the ex-chairman of the Federal Industrial Relations Commission; they also account in no small measure for the savage doctrines of the I. W. W. and other anarchistic organizations.

IN a recent issue of *Science* Mr. Joseph W. Richards, an honored professor and an effective writer, makes a protest against the publication, by general scientific societies, of numerous abstruse papers on specialized research. He calls it "an anachronism of the most glaring kind." And adds, "Is it fair to any man on earth to ask him to pay for the whole set of papers in order to get the one or two which he can read understandingly and profitably? You surely cannot expect a man of understanding to risk acute mental digestion by trying to assimilate the specialized articles entirely outside of his ability to absorb. Then why should any individual be expected to pay good money for so much material useless to him?" What the Lehigh professor says of the proceedings of the National Academy of Science can be said of the publications of societies less academic in character. Pan-scientists have their counterpart in pan-technologists.

Standardization

Any serious attempt to standardize the usages and terms current in professional practice is deserving of support. The latest effort in this direction is the report of a committee appointed by the Mining and Metallurgical Society of America. That organization is small in membership, but strong in its members; so also the committee is not large, but distinguished. The recommendations are not made to the mining profession in general, but to the members of the Society, numbering about 250 engineers and geologists. As a text for its report the Committee takes the standards advocated at intervals by the Institution of Mining and Metallurgy in London. On one matter the Society's committee is in such perfect accord with the Institution that the recommendations made by the latter are adopted verbatim; we refer to the unauthorized use of publications. In regard to 'ore in sight' the Committee emphasizes the need for defining the gradation of mental vision, but does not, we regret to say, recommend the abolition of a misleading phrase. No ore is 'in sight' until it is in a bin, if then; it was a pity therefore that the other common terms, such as 'in reserve,' 'blocked out,' 'assured,' and so forth, were not passed in review, with recommendations to adopt those that are most nearly descriptive of the various stages of assurance involved in the act of estimation. The Institution prescribed that the engineer "should demonstrate that the 'ore' so denominated is capable of being profitably extracted under the working conditions obtaining in the district." Surely this was a

wise provision; what is the use of estimating the tonnage in a block of ground until it has been explained clearly how much of it, and why, is 'ore,' that is, lode-matter from which a profit can be won at the end of the operations anticipated. It is true the Committee asks the engineer to "clearly define what is meant in the report by the terms 'ore in sight,' 'ore blocked out,' or such other general terms as he may use referring to the quantity and quality of the ore," but the Committee itself has failed to "clearly define" what it means by 'ore,' for 'quantity' and 'quality' mean nothing without reference to the cost of exploitation and realization. As regards screens, the Committee rejects the Institution's standards, founded on wires and openings of equal size, preferring instead to use the Tyler scale, which is based on the size of the openings alone. The Committee believes that this is "the proper and logical basis." In the use of weights and measures, the Committee urges the adoption of the metric system in all reports dealing with South American mining enterprise; also the employment of the Centigrade thermometric scale. This is wise. In measures of water, the Committee opposes the Institution's suggestion to drop both 'miner's inch' and 'sluice-head,' in favor of definite statements of flow in cubic feet per minute. The Committee wants 'miner's inch' retained and 'sluice-head' rejected. One represents American, the other Australian, usage. Both are equally objectionable as standards of measurement. If the 'miner's inch' is to be defined as 1.5 cu. ft. per minute, why not state the number of cubic feet per minute in the first instance, and so avoid the use of a measure that varies greatly in different localities? The Committee opposes the use of the Imperial gallon, just as the Institution rejected the American gallon. Both are equally justified, and both have failed in recommending a unit suitable for international usage. As regards assay-values the Committee makes the good suggestion that "all samples should be dried at 100°C. before being subjected to assay or analysis, and that the report should definitely state that this precaution has been taken." The Committee joins with the Institution in recommending the use of the 'fluid ton' of 32 cubic feet, because it is approximately equal to the short ton, which, of course, is the standard weight. It is recommended that pennyweights and decimals thereof be "completely eliminated." Is this well? In most gold mines, where the grade of ore is normally below an ounce per ton, it is convenient to use the pennyweight because it is the equivalent of a dollar. Why accept 85 shillings and $20.67, alternatively, as "a convenient constant" for the value of an ounce of fine gold? The Institution and the Committee concur on this point. An ounce of fine gold is worth slightly less than 85s.; why then use the exact sum, $20.67, as the equivalent? Why not $20, which is a more convenient constant, and the one actually in general use? The difference between $20.67 and $20 is less than the margin of error in the estimation of the average assay-value of the ore in a gold mine. By way of further remark we may say that all standardization committees are in jeopardy of criticism, therefore we venture to suggest that this Committee should have tried to avoid issuing a "partial" report; it should have been impartial. Perhaps it was intended to say that the report was incomplete. The last of six headings is called "the latter"; that is contrary to Hoyle and other authorities on the game. The Committee says: "We recommend concerning the use of this term the following." We recommend that the sentence be torpedoed and that the *disjecta membra* be re-arranged in orderly sequence. "The infraction of this resolution" suggests something heinous; the gentlemen of the Committee probably mean 'the disregard of this regulation.' However, for fear of being deemed frivolous we shall close these remarks in more serious vein. We recognize the good purpose, and the probably good results, of the Committee's efforts. Therefore, we urge them to go a step further. Why not mobilize a joint committee of the leading mining engineering societies with a view to advancing the cause of standardization? Otherwise, only confusion will result. Of course, the Committee above-mentioned can say that its recommendations are not intended for the profession at large, but some engineers are members both of the Institution and the Society that have made these praiseworthy efforts to standardize. Moreover, the secretary of the Mining and Metallurgical Society of America announces that he expects the co-operation of the Canadian Mining Institute. Why not organize a committee to represent the two societies just mentioned, the Institution of Mining and Metallurgy, and the American Institute of Mining Engineers? The joint committee of the four leading societies would be in a position then to recommend standards that should be honored by all mining engineers speaking the same language. The gentlemen whose report we have discussed are amply competent to take a lead in the matter.

American Mining Congress

To live is an accomplishment: to survive is a feat. Men and organizations alike gain in reputation by mere persistence of effort. The unfit disappear; the morally weak cease to exert influence. As we recall the early days of the Mining Congress, its dubious character and its uncertain scope, and now recognize its strength of purpose and assured position, we are moved to congratulate the founders and their successors. Turning to our back volumes we find the progress of the Congress recorded year by year. It was organized, and convened for the first time, eighteen years ago. The idea was born, if we remember correctly, in Gilpin county, Colorado. The agitation for the free coinage of silver was at its height and the worthy citizens of Gilpin thought it well to remind the world that gold was important also. So they sounded the call for a 'Gold Mining Convention.' On July 7, 1897, the delegates assembled at Denver, but they had hardly concluded the preliminaries before the stereotyped free coinage resolution was passed by acclamation. Whereupon the Gilpin delegates, much cha-

grined, walked out. The Congress was abandoned by its originators and beeame something quite different from what they had planned. At a later date it barely escaped capture by the Western Federation of Miners. So it has had a chequered career. At its start, and for five years thereafter, it was known as the International Mining Congress, a grandiose title that belied any useful purpose within its power to accomplish. In those days, in absurd contrast with its name, the principal propaganda of the Congress was the creation of a Federal Department of Mines and Mining with a Cabinet Minister at its head. Mr. Irwin Mahon was the first secretary and the guiding spirit of the organization, aided by a group of mining promoters and politicians, to whom the annual session afforded an opportunity not only for ventilating sundry schemes of governmental paternalism, but also a chance for boosting the particular mining locality in which the Congress foregathered. At those meetings a great deal of windy talk was made, pseudo-experts aired their opinions, and pompous persons won newspaper notoriety. In its third year the Congress was on the verge of collapse. At that time the following comment appeared in our pages: "The Milwaukee meeting was of no avail. If real mining men could continue to believe that their attendance would be productive of benefit they would attend even at some personal sacrifice, but the average miner is too busy a man to go a thousand miles to listen to essays by people who do not know what mining is."

Nevertheless, even these early defects did not kill the Congress, because amid the chaff there was some good grain and among those attending the suecessive conventions were some serious men. In 1902, at the Butte meeting, Mr. James H. Richards presided, and for eight years thereafter he served, with persistent zeal and loyalty, as President. To him mainly the Congress is indebted for an escape from its early divagations. He was assisted by the late Ernest R. Buckley, who succeeded him in the presidential chair, in 1910, and would have continued to be an influence for good if he had not been called away untimely. Mr. Richards brought several mining engineers of high repute into the Congress and slowly won for it a national recognition. Men like Messrs. Charles W. Goodale, S. A. Taylor, James W. Neill, James W. Malcolmson, and James W. Abbott (is there something mystic in these particular initials?) were among the first engineers to give help; then Messrs. James Douglas, David W. Brunton, Hennen Jennings, J. Parke Channing, Edmund B. Kirby, and S. W. Mudd took a hand. The United States Geological Survey was among the first to recognize the Congress, deputing various geologists to read papers. In 1908 the Director of the Survey, Mr. George Otis Smith, himself took part in the proceedings. The President was persuaded to nominate delegates as early as 1904, and in 1911 President Taft addressed the Congress when in session at Chicago. In 1906 Mr. James F. Callbreath became secretary and at the same time permanent headquarters were established at Denver, together with a bureau of enquiry, a library, and an exhibit of ores. Out of the early propaganda for a Mining Department eame the more practicable demand for a Bureau of Mines, which was established in 1910. This is to the credit of the Congress; also the fact that it endorsed the late J. A. Holmes as the first director of the Bureau. The Congress gave its support to the efforts made by the Post-office department to check the sale of stocks in fraudulent mining schemes and in 1906 drafted a bill providing for the punishment of fakers. Its efforts in this direction have not been ineffective. At the annual conventions the need for amendment and uniformity in the mining laws have been advocated by Messrs. W. R. Ingalls, Horace V. Winchell, and George W. Riter; a correction of various Alaskan regulations has been urged by Messrs. John L. Steele, Maurice D. Leehey, and Falcon Joslin. Prevention of accidents in mines, the excesses of the Forest Service, and railroad-building in Alaska were other matters that received attention at the annual sessions, with good results, for the public and the press were undoubtedly made to understand the need for reform, and members of the legislatures were given useful hints for the enactment of statutory changes.

Now the directorate of the Congress and the personnel of its committees are unexceptional, and the general character of its discussions has been raised to a dignity quite foreign to those silver-tongued harangues and boostings that used to mark the early sessions. We think the Congress deserves the general support of those engaged in mining. We need a parliament of mining operators and engineers to assemble periodically with a view to crystallizing opinion on matters of moment to the industry. To strengthen itself for its main purpose the Congress should discard its statistical work, which is being done, and done better, by the Federal bureaus; it might as well drop the enquiry department and the ore exhibit, both of which deflect its aim. No; the work that the Congress can do is plain enough. It must be an annual convention of those interested in the business of mining—the miners, superintendents, operators, capitalists, and engineers actually engaged in a great industry, together with the Government officials, professors, journalists, and others able and willing to contribute to the general stock of ideas on the subject. If the American Institute of Mining Engineers had chosen, it might have assumed leadership in all matters affecting mining, but under the guidance of Dr. Rossiter W. Raymond it early adopted the policy of keeping clear from any commitment of opinion on public affairs, so that there was room—and need—for an organization that could perform this function. None is more important. The social obligations of good citizenship call upon the members of the profession and the bigger brotherhood of all those actually engaged in mining operations to unite in giving effective support to the American Mining Congress. We hope that the San Francisco meeting, under the presidency of Mr. Carl Scholz, may be marked by a large attendance and unmistakable public support.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Big Business

The Editor:

Sir—Your editorial in the issue of July 10, and Mr. W. L. Austin's letter of July 24 induce me to give my views on the subject.

Big Business is an example of combined effort and owes its success to the union of many men, wisely guided and provided with ample capital, working efficiently for a common purpose. Among the many questions that arise concerning their operations, the most important seems to be: Is Big Business a development in harmony with the evolution of society, or is it an artificial and transitory phenomenon that will disappear like muzzle-loaders and hoop-skirts, or will it be found as necessary to the normal development of society as telephones and submarines?

Solomon advised an idle gentleman to learn from the ant and though an investigation of these little insects may not teach us much, yet it is of interest to note that they are the most numerous and perhaps the most successful forms of life that exist on earth and that much of their success is due to combination. Indeed, some entomological authorities have said that the present age really ought to be called the "ant era." The residents of Oakland and Berkeley have some faint idea of the power of combination when they encounter the tiny Argentine ant who is smaller than this letter l and yet when joined in thousands has worried and is still troubling no inconsiderable portion of the inhabitants of those bay-cities. But for really big business in the ant line one should study the long columns of the driver ant, whose onslaught no earth-dweller can resist—the ravening lion, the gigantic serpent, and man himself all flee when the driver ant approaches. This insect is perhaps the best example of big business that the world offers; unfortunately his power is used with no regard to the rights of others.

Omitting from consideration many other forms of animal combination, and turning to humanity, we find that as man develops he dwells in larger and larger communities and combines his efforts in ever-increasing masses. The history of the mechanical arts shows, first, the isolated worker in his own dwelling; later, with the invention of steam, the factory system developed and men, women, and, unhappily, children gathered together in thousands. As the latest development we see the owners of these factories, workshops, and mines combining together into Big Business. A little consideration of the history of these great combinations shows that they are a natural and helpful development of society and that an attempt to restore unlimited competition by legislation is a retrograde movement, likely to be futile as was the attempt of Mrs. Partington to brush back the swelling tide of the Atlantic with her broom.

That Big Business has abused its power is certain, but the remedy is at hand and does not lie in futile attempts to restore competition, but in regulation. The power of regulation is inherent in government and has already been exercised in regard to railways to the extent of partly destroying their credit. The principles on which the regulation of Trusts should be based are the adequate protection of the actual capital invested and the absolute destruction of unfair competition. Such consolidations as those in which the Pittsburg iron and steel manufacturers made their millions by selling their plants to the United States Steel Corporation at grossly inflated prices should be guarded against. And that form of competition wherein a Trust sells its products below cost for the purpose of compelling a competitor to join the Trust or to be forced out of business, and perhaps ruined, should be made a criminal offense. To fix the exact return that should be allowed on invested capital, having due regard to the risk involved in most business transactions, and to regulate the amount of profit legitimately due for promotion services will be a matter of great difficulty. The wit of man has accomplished more difficult tasks and there is no reason why the problem of the regulation of the Trusts cannot be solved without attempting to restore competition. The rigid rule that Trusts must be destroyed because their operations are large is based on sentiment, not on reason. Moreover, the separation of the Trusts into their component parts does not seem to have been beneficial to the consumer, who is the one to be considered. This is shown by the results of the dissolution of the Standard Oil Company, where the market value of the separate companies much exceeds that of the parent company before dissolution; this means that the total amount of the profits of the separate companies is larger than when they were united, and as the expense of operating the separate companies is much larger than that of operating the combination the total loss to the consumer is very great. The breaking up of the Tobacco Trust does not seem to have helped anybody, except the newspapers, for the price of the products is no lower and the expenses of the smaller dealers have been increased by cut-throat advertising.

In conclusion it seems plain that as consolidation makes for economy and efficiency—this is well shown

in comparing the results obtained in the anthracite fields of Pennsylvania by the large companies as compared with the smaller operators—it should be encouraged and not repressed. Consolidation, or Big Business, is a natural development and cannot be replaced by competition without great loss to society. When the powers gained by consolidation are abused; when the Trusts are unfair to competitors or become too powerful financially, or politically, they should be regulated and not destroyed.

Germany, which apparently stands at the head of the nations as regards efficiency, is not afraid of Trusts, but insists on their formation and much of her business success is due to this policy.

W. H. Shockley.

San Francisco, August 16.

The Amateur Miner

The Editor:

Sir—Since reading your editorial contained in the issue of July 31, entitled 'The Amateur Miner,' I have often thought as to what would have been my answer to Mr. Gray had he come to me for advice as to how to enter properly the mining business and continue it with pleasure and profit. The following is the result of my deliberations:

It requires a good round sum of money to acquire a mine by purchase, where usually a small sum is sufficient to secure a prospect which would justify one in expending the necessary money to develop it into a profitable producer. Judging from your description of the gentleman, he would be perfectly able financially to place in the field a prospecting party, and it would appear also that to obtain a mine in that manner will appeal to him with the greatest force—he would be able to take part in the actual finding, organizing, and operating of a mine. I would therefore have advised him to enter into arrangements with a man of experience, preferably one who has made a speciality of mining geology, not only theoretically but practically also, and engage him as the head of a small prospecting party. No doubt such a man would be willing to give his service on the basis of a small salary and in addition an interest in any mining property that was discovered and located by him. Such a prospecting party should consist of three men, the two, besides the chief, to be paid good miner's wages without any interest in discoveries, and one of these should take care of the team, do the cooking, etc. The wagon would be headquarters, and be moved from place to place as the work of prospecting progressed.

This manner of prospecting is by no means new, with the exception that it has not been my experience to see such a party headed by a responsible and trained geologist. The old way was to start out a couple of men with a wagon-load of supplies, who were then left to their own devices—no system of reports was arranged for, and indeed, such men are incapable of writing concise or intelligent statements as to the mineral occurrences in the country traversed, or the discoveries made. But with a competent man in charge, a systematic detailed account of each day's work would be recorded, and when an important discovery was made, his report would receive the intelligent consideration of his principal or any group of investors gathered together for the purpose of furnishing funds for development and equipment.

An important question would then arise as to where would be the most likely territory for the party to commence operations. No doubt the chief of the party would have some views on this subject. My own suggestion, having in mind the approach of winter, would be for the southern parts of Arizona, Nevada, and California, which I believe to be promising fields, and where prospecting can be carried on from now until next July without any particular inconvenience. At times an opportuntiy would present itself for obtaining a promising prospect which had already been discovered by others—such a contingency may well be anticipated, and advantage taken of it when offered.

The cost of such an expedition, carried out as indicated, would amount to $500 per month, and the first cost of outfitting with team, wagon, supplies, etc., would be $500 or thereabouts.

It is my candid opinion that if Mr. Gray followed the plan that I have outlined, and that a reasonable share of good fortune attended the party, he would finally become the owner of a paying mine; he would also be engaged in a clean business, a business full of adventure and health, and which is often of a highly profitable nature, and furthermore, when you next had occasion to refer to him in the columns of your paper, it would be as Mr. Gray, the mining operator, not Mr. Gray, the amateur miner.

Ernest G. Locke.

Rochester, Nev., September 1.

The Ontario Nickel Commission

The Editor:

Sir—On returning to the city after an absence of several weeks in the north, my attention was drawn to an editorial note in your issue of August 7, page 194, in reference to the Nickel Commission recently appointed by the government of the province of Ontario.

"Accidents will happen in the best regulated families," and it is not surprising to find that even the carefully and brilliantly conducted Mining and Scientific Press once in a long time falls into error. The following paragraphs are tendered as corrections:

(1) "In order to exercise greater control over the industry, the government of Ontario has appointed a commission to enquire into the feasibility of refining the nickel matte in Canada." The commission is instructed to investigate not only the refining of nickel but the whole nickel industry, including the character of the deposits in various countries and the taxation of the Ontario mines.

(2) The statement "It is fortunate that the Imperial government insisted on the appointment of an experienced metallurgist as chairman of the commission"

shows that the writer of the editorial is not cognizant of the facts. The Imperial authorities recommended the chairman at the request of the Ontario government. The Imperial government, it is scarcely necessary to say, does not assume or exercise autocratic powers. The constituent parts of the Empire not only enjoy full liberty, but the Empire by recognizing its treaty obligations and Hague conventions seeks to promote liberty throughout the world.

(3) In the last sentence it is said that "The commission looks like a sop to public sentiment, for it is extremely unlikely that its report will be applicable to any emergency created by the War." It is here assumed that the nickel situation is a new one, created by the War. Such is not the case, there having been agitations for investigations or more complete governmental control at various periods during the last 25 years. Discussions have taken place in the legislature, at the annual meetings of the Canadian Mining Institute and elsewhere.

Toronto, September 1. W. G. Miller.

The Prospector

The Editor:

Sir—In a recent article in your magazine, lent me by a friend, entitled 'Speculation in Mining,' you manifest much concern as to the lack of interest shown toward mining by the public generally. I regard your enlightened interest in the matter as a sign that the prospector may yet come back into the field from which you have helped to drive him. If you will review your issues for a few years back, and right up to July last, you will find voluntary advice to would-be investors in mining ventures to investigate by means of thoroughly trained men, and then place their money in something else. Scarcely an issue of the mining journals but contains warnings to the public. Caution is the bell-note in any magazine you may pick up. The depressed state of mining requires a less number of trained men. They are conducting street-cars, etc. This condition the prospector hails with joy. When the engineer trained by magazines to knock mines and the prospector is building county-roads, the magazine too will go. Then the prospector will return. Foundry-men will send their salesmen to him, and help out any worthy mining effort. Then, and not until then, will the public's point of view change in favor of mining.

The trouble with you magazine writers is your perspective of the mining situation is viewed from a wrong angle. Your mythical prospector with a mountain of ore for sale appeals to no one, and the highly technical language with which your mythical engineer deals a solar plexus blow to that prospector's report is not calculated to remedy existing conditions. The magazines are largely responsible for the public attitude toward mining. Caution, caution, creeps into every mining report from engineers, until the public regards us as a lot of fakers. The mining field is being combed for a prospect that has 10,000 tons of ore in sight at a nominal price. Nothing else can get past in this day of caution.

Havilah, Cal., August 31. Wm. W. Waters.

Distress in Russia—An Appeal

Just as we were going to press we received the following telegram from Mr. Edward T. McCarthy, one of the most honored men in the profession of mining. He is at Moscow, on his way from London to Siberia, and has been strongly affected by the sight of the unspeakable misery of the peasants fleeing from the War zone into Russia's old capital. We believe that this appeal will not be fruitless. Any contributions sent to this office will be forwarded promptly to the American embassy in London.

Moscow, September 13, 1915.

T. A. Rickard,

420 Market Street, San Francisco.

Have cabled Edgar asking Hoover if he would raise American fund ten thousand pounds or more help refugees pouring into Moscow. Small English community supporting hospital, hundred fifty beds. Can only feed three thousand daily, being limited by funds. Refugees mostly have only summer clothing. Accommodation, food, clothes hopelessly inadequate. Moscow already receives one-third total wounded. Authorities overwhelmed new influx refugees. Private aid alleviate awful distress. I appeal to my old American friends. Lose no time. Send succor. Excellent English organization, with co-operation American consul, doing utmost in this frightful calamity. Words fail describe terrible sufferings of these patient peasants. Immediate preparation against winter urgent. Your previous knowledge Russia enables you to realize what this means. Frisco will, I know, respond.

McCarthy, care Woolmer.
Post-office Box 19, Moscow.

[Edgar means Edgar Rickard. Hoover refers to Herbert C. Hoover, of course. Woolmer is H. C. Woolmer, consulting engineer to the Spassky and Atbasar mines.—Editor.]

Costs at the Jumbo Extension

During the year ended June 30, 1915, there was 16,420 tons of ore produced, yielding $39.64 per ton. Expenses were as follows.

Item of expense.	Per ton.
Mining	$ 3.12
Development	3.54
Milling, including freight, royalties, marketing concentrate	1.05
Freight and treatment on ore shipped	7.29
Freight and treatment on concentrate shipped	0.24
General expenses, including office, legal, corporation, administrative, etc.	2.39
Bullion tax	0.32
Construction and new equipment	1.02
Total	$18.97
Net realization	20.67

Goldfield, Nevada, produces 40% of that State's output of gold, and Tonopah 73% of the silver.

Why is Flotation?

By CHARLES T. DURELL

Some of the fundamental principles of this concentration 'upside down,' as it may be termed, being such a new method, have been overlooked. There has been such a mad scramble to get results in advance of the 'other fellow,' and to penetrate the cloud of secrecy enforced by patent litigation, that there has been little time to answer the question as to why the heavier mineral floats and the lighter gangue sinks. In this buzzing cloud of secrecy the student can distinguish such phrases as 'froth flotation,' 'surface tension,' 'oil-films,' 'DeBavay float,' 'liquid skins,' etc., all of which tend to confuse rather than answer the main question. A few articles in the magazines have given various data, phenomena, causes, and effects, but no definite theory explaining these has been clearly stated.

The action of any flotation machine in successful operation seems quite simple, the mineral floating in preference to the gangue, giving rise to the phrase 'selective flotation.' All that is necessary for the one type of machines is to place the mineral particles gently on the surface of a liquid so that they will not sink or, in the other type of machines, attach to them something of a lighter specific gravity than the liquid so that they will rise bodily to the surface. On the face of it, this is quite simple. Apparently the simplest of all is to attach 'life-preservers' or something buoyant to the mineral particles.

Herodotus describes how "the virgins drew up gold by means of feathers daubed in pitch." Therefore this or an oil, for instance, can be employed to float mineral. The Elmore patents for this flotation, due to the buoyant property of oil, are still in effect. Due to the large quantity of oil necessary, as well as other things that make this method of no commercial value at present, the only 'why' to be considered in this class of flotation is the selective action, which will be discussed later.

The simplest and cheapest 'life-preserver' is undoubtedly the pneumatic one, which is beyond the time of Herodotus or perhaps even history itself, since eggs and cream were surely frothed before the stylus was known. Any little girl who has helped her mother in the kitchen can tell how any foreign substance, such as a piece of egg-shell for instance, is buoyed up and brought to the surface by these bubbles. These are bubbles of air, and what could be cheaper for the manufacture of these simple pneumatic 'life-preservers?' It is true that Delprat, with his process, uses carbon dioxide, but this is simply a case of using a by-product that would otherwise go to waste.

Therefore the whole sum and substance of this apparently complex problem of ore concentration by flotation, now surrounded by a cloud of secrecy, consists in either attaching mineral particles to gas bubbles, preferably air, or attaching air bubbles to mineral particles. It amounts to the same thing whether the bubble be attached to the solid or the solid attached to the bubble. In the one case, a 'surface tension' type of machine is used for the concentration, while in the other a 'froth' type of machine is used. These will be taken up later.

Therefore the two prime requisites to flotation are:

1. Attachment of bubbles to solids;
2. Creation of selective action of bubbles for metallic particles instead of for the gangue particles.

Since the all-important requisite is the attachment of gas bubbles to solids, it is logical to investigate this phenomenon first with the simplest materials at hand—air and water.

Far back in primeval time the progenitors of the fishes made air bubbles that came to the surface of the water and yet we, a few years ago, knew but little more concerning air bubbles in water. There was no reason for these aquatic things knowing the ways that air can exist in water but there was no excuse for our building Pachuca tanks, blowing air in at the bottom and then writing a beautiful chemical equation to show that these air bubbles were necessary for dissolving gold. Visible bubbles of air, which have been blown into the water, can in no possible way sustain the life of a fish. Neither can they aid one iota in dissolving gold in a cyanide solution. Nor can visible bubbles of air, introduced into a liquid in this way, be attached to solids to aid in flotation. Available air or oxygen for things of this nature must be air actually in solution. A fish may be breathing freely at the bottom of an aquarium. If the water be warmed so as to expel the air, the fish will rise to the surface and try to jump out. Only nascent hydrogen can unite with arsenic in the Marsh test. In the same way, only nascent oxygen from the dissolved air can act as shown in the chemical equation:

$$2\,Au+4\,K(CN)+H_2O+O=2\,KAu(CN)_2+2KOH.$$

when gold is dissolved. Only nascent gas can be attached to mineral in the flotation process. This fact is quickly demonstrated by introducing a small jet of air into the bottom of a flask, filled with water, where rests some pulverized ore, the metallic particles of which are in a perfect float condition. Why will the mineral particles, which almost float of their own accord, refuse to attach themselves or be attached to the small bubbles of air? To prove that these same metallic particles can be floated by bubbles of air, it is only necessary to remove the jet and place the flask on a hot plate when they will immediately collect air driven out of solution by the heat and rise to the surface. Some one may here

remark, that the rise of temperature of the solution causes enough expansion of the air bubbles already attached to the metallic particles to produce flotation. Anyone familiar with the law of Henry will know this is not the case on noting the greatly increased size of the bubbles. Why, then, cannot air bubbles be attached to mineral particles in the place of nascent or dissolved air?

All great facts, when thoroughly understood, are demonstratable by simple experiments with material at hand. Sometime when the young man at the soda fountain absent-mindedly forgets to stir your cherry phosphate and sets before you the straws, demonstrate the above fact to your satisfaction while the nascent bubbles of CO_2 form and rise to the surface of the liquid. Crush the straw slightly to reduce the size so that only a minimum of air can be forced through. With this straw, blow air into the colored syrup in the bottom of the glass so as to form a few small bubbles that can be watched closely. These bubbles that come to the surface are colored. Why? The air itself is not colored. Therefore, since the only part of the liquid that is colored, is in the bottom of the glass, the air must be enveloped in the same identical portion of liquid throughout its passage from the bottom to the top of the glass. In other words, the air bubble, on being introduced into the liquid, is immediately surrounded and inclosed by a film of liquid, which remains with that air bubble throughout its passage just as if it were a part of the bubble. Here is a concrete example of surface tension, a force that can be measured, as explained in any text-book of physics.

This phenomenon is worthy of investigation. The bubble rises to the surface of the liquid by reason of the force of gravity. That is, the force of gravity is greater than adhesion of the molecules of the air for the molecules of the liquid; otherwise the air would remain in the liquid. The molecules of the liquid move freely among themselves according to the definition of a liquid. In other words, the force of cohesion of any single molecule within the liquid is equalized by the cohesive force of other molecules of the liquid. An extraneous force would be required to separate them. An air bubble, for instance, introduced into the liquid, unbalances this cohesive force. It is self-evident that this force of a molecule must act equally in all directions from that molecule. Therefore molecules of the liquid adjacent to the air bubble have their force of cohesion on the one side satisfied by that of adjacent molecules of the liquid, while, on the side of the air bubble, there are no molecules of the liquid to equalize this force. Being statical, this force must be equalized by that of adjacent like molecules in a transverse direction. Since a force of cohesion was already in existence between these adjacent molecules this force is thereby multiplied so that there then exists a greater cohesive force between the molecules immediately surrounding the air bubble than that existing between the molecules in the interior of the liquid. This force is 'surface tension;' it is so great that these molecules of the liquid surrounding the air bubble are firmly held together and torn loose from adjacent molecules of the liquid as the bubble rises to the surface. That is to say surface tension causes the molecules of the liquid to form a film around the bubble and remain with it to the exclusion of like molecules during the time the bubble remains in the liquid. To all intents and purposes, this film is seen to be the same as if it were a membrane of some solid. The air in these bubbles can no more come in contact with the liquid through which it is passing than it could were it inside a toy balloon, for instance. The bubble may be said to be enclosed in a 'liquid skin[1].' Therefore to attach this bubble to any substance, this liquid skin must first be penetrated or broken. As seen from above, this requires some force.

As shown above, the force of chemical affinity is not sufficient to overcome this surface tension. So then, it could hardly be expected that a mere adhesive force would be greater than this surface tension. Therefore, to attach gas to solids in a liquid, it is first necessary to dissolve the gas in the liquid and then expel it in a nascent state.

There are at present only three known ways of forcing a gas mechanically into solution so that it actually occupies the interstitial spaces of the liquid molecules: (1) beating it in with stirrers or paddles as is described, for instance, in the patent papers of the Minerals Separation Co., where propellers or centrifugal pumps are used; (2) dividing it into such minute portions that, by capillary force, it is actually taken into solution, as is done in a Callow cell; and (3) introducing it as a surface film surrounding a jet of fluid by means of surface tension, as is done by a method under process of patent.

There are also three methods of expelling dissolved gas from a liquid that are of vital interest to the matter in hand: (1) Super-saturation, so that the excess gas comes out of its own accord; (2) heating, which expels some of the gas by increasing its volume; and (3) reduction of pressure. The present Elmore machines work the pulp in a vacuum, taking advantage of the fact that "at constant temperature, the gas dissolved in a given volume of liquid varies directly as the pressure"—Henry's law.

Since it is easier to work in the open air than in a vacuum, flotation machines using the principle mentioned, of forcing more air into solution than the liquid can hold, are preferable. The second method mentioned, of expelling dissolved gas by heat, aids the super-saturation type of machine in two ways: (1) nascent gas is expelled from the liquid to be readily attached to solids for flotation; and (2) dissolved gas is expelled from the solids so that gas bubbles may be easily attached to them. Here lies the whole secret of flotation.

[1]A striking experiment to show these liquid films is as follows: To a beaker partly filled with a colorless oil, add a small quantity of permanganate solution. Blow air through a finely drawn-out glass tube into the permanganate solution now on the bottom of the beaker. Air bubbles enclosed in the colored liquid film rise through the oil and break at the surface, because of the expansive force of the gas. The colored water drops back through the oil exactly in the same manner that a balloon, bursting, drops to the earth.

No solid can be floated unless it contains some dissolved gas. Why? For the reason, explained above, that the enveloping 'liquid skin' cannot be penetrated or broken. It was shown above that a gas bubble is surrounded by a film of liquid. A solid in a liquid is, in the same way, surrounded by a film of the liquid, for the same reason. Therefore, in a liquid, the molecules composing the film around a gas bubble would have no more attraction for those composing the film surrounding the solid than they would have for any molecules in the liquid itself. Hence the bubble would not attach itself to the solid. It is seen then that flotation has for a foundation a subject of which practically nothing is known—occlusion of gases.

It is self-evident that the same cause which tends to super-saturate a liquid with gas will also have the same tendency to super-saturate a solid contained therein. And also the same cause that tends to dispel from solution the dissolved gas will also tend to dispel the gas from a solid in this same liquid.[2] Therefore a solid in a liquid becomes a nucleus for the formation of bubbles. This is easily demonstrated by the formation of vapor bubbles when water is boiled.

The surcharging of a liquid with a gas, tends to surcharge any solid in this liquid—on account of diffusion. The adhesion of the gas for the solid, therefore, will tend to condense the gas on the surface of the solid. Sufficient condensation will collect enough molecules of the gas to form a bubble on the surface of the solid. The same effect, due to diffusion of gas in the opposite direction, will be produced by causing the gas to be expelled from either the liquid or a solid contained in this liquid. An example of this is the dumping of a cold ore into the hot solution of a flotation plant. Bubbles immediately tend to form on the ore particles, by reason of cohesive and adhesive forces, and have the tendency to be enlarged by the gas in solution in the liquid.

It is natural, therefore, to suppose that solids with high occlusive power for gases have a greater tendency to float. Here, then, is a cause of selective flotation. Hezekiah Bradford's patent No. 345,951 is the first to recognize this. Speaking of metallic particles, he states: "These floating particles appear to possess some peculiar qualities which repel water from their surfaces, especially when such particles are exposed, even momentarily, to atmospheric air[3]." Later this phenomenon caused trouble to, instead of benefiting, Hebron, who says in his patent No. 474,829, an interest in which is assigned to Carrie J. Everson: "I expel from such mineral and metal particles—the air and other gases—by producing as far as practical a vacuum—or, and preferably, by applying heat to the ore, thereby obtaining the desired expulsion of air and other gases."

Why then do minerals (here in these patent papers meaning solids containing metal), and especially sulphide minerals, occlude gases more readily than other solids? It is only necessary to look into the subject of ore deposition for the answer. Primary sulphide ores are changed near the surface to sulphates, carbonates, oxides, etc.; in other words, chemical affinity assists sulphides in absorbing oxygen or carbon dioxide. Hebron and others discovered, by the aid of the microscope, that most mineral particles to be saved by concentration have larger pores and surfaces of larger extent than equal sized 'gangue' particles. This gives a greater chance for gas occlusion, which is another cause of selective flotation.

There is practically no adhesive force existing between oil or fatty substances and water. As a general rule, an oil is but slightly soluble in water or water in oil. Therefore water will not adhere to a surface wetted with oil or oil will not adhere to a surface wetted with water. Also an oil, due to its property of capillary attraction, has that power of entering solids. Therefore, due to larger surfaces and pores, most metals and sulphides are capable of absorbing oil so that sufficient oil can be attached for agglomeration and flotation. This selective flotation, as mentioned above, is not now worth considering, because so large a quantity of oil is necessary. A small quantity of oil then cannot create selective flotation.

Mickle's experiments[4] showed that none of the minerals tried hot, cold, or with reduced pressure floated on oil under any of the conditions where floating would take place on water. This was to be expected, since the specific gravity of oil is less.

What then is the potent factor for selective flotation? It is the ability to vary the "angle of hysteresis[5]." It has been seen from the above that solids occlude gas which can be expelled from them. If this gas be expelled from them when they are in a liquid at a time when gas is expelled from the liquid, they become the nuclei for the formation of gas bubbles which will float them under certain conditions. Now, therefore, if it be possible in an ore mixture to drive out a considerable portion of the gas from all the particles, there will be insufficient remaining in the 'gangue' to float it while the mineral containing more gas will float to the surface. It has been found, for instance, that sulphuric acid in very small quantity added to water will decrease the angle of hysteresis to that point where quartz and similar 'gangue' will sink, while that of the metallic particles remains practically unchanged.

Since an acid in very minute quantity will produce this effect, it is not due to rise in temperature or reduction in pressure, which would drive out the occluded gas. This must be caused then by no ordinary phenom-

[2]"As in the case of liquids, we would expect that the amount of gas adhering to the surface or absorbed in the pores of a solid would vary with the nature of both of the solid and of the gas, with the extent of the surface, with the fineness of the pores and lastly with the temperature, becoming less as the temperature rose." Josiah P. Cooke, Jr. 'Chemical Physics.'

[3]He describes a traveling belt with one end in water to take advantage of this fact. This antedates, and is the same principle as, the Macquisten tubes.

[4]Proceedings of the Royal Society of Victoria. Vol. 23. Part 2 of 1911.

[5]Transactions Institution of Mining and Metallurgy, 1912, Presidential Address by H. L. Sulman.

enon. The only way that an acid can act in this manner is in the capacity of an electrolyte especially when diluted to its dissociation point. That is, complete ionization exists. Yet with this extreme dilution, gas is expelled from a solid contained therein. In other words, equilibrium does not exist. Why? It is on account of these ions of the electrolyte which cause this displacement of equilibrium between the solution and the gas dissolved in the solids within this solution. This then resolves itself into a simple case of osmotic pressure. The surface of the solid is the septum. The ions of the electrolyte enter the solid while those of the gas leave. Since the carrying solution is saturated with gas already, bubbles form; and this action continues until the eutectic point is reached. So far an acid (sulphuric on account of its cheapness) has been used as the electrolyte, because it produces such a great change in the angle of hysteresis.

In the future, as more is learned concerning flotation, the finer and more delicate manipulation will be better understood, permitting an alkaline electrolyte to be commonly used. This will allow of the selective action for mineral particles other than sulphides so that, for instance, cerussite or malachite can be separated readily from gypsum, quartz, etc. This is not to be confused with Horwood's "differential" or "preferential" process, whereby the surfaces of some sulphide minerals are oxidized by roasting to prevent them floating with another sulphide in a mixed sulphide ore.

While, as stated above, the fundamental requisites are the manufacture of 'life-preservers' and the attachment of these to the mineral particles, it is still necessary to rescue these particles. Bubbles, on coming to the surface of a liquid, burst if not protected, and the attached mineral particle sinks. Why do they burst? (1) Relief of pressure, so that the contained gas expanding exerts more pressure on the liquid film, (2) adhesive force of contained gas for the atmosphere, or (3) evaporation of the film causes this bursting. The greater the supersaturation, the greater the interior gas-pressure of the bubbles, so that they in reality explode. This is the case with bubbles in a glass of soda-water, for instance. How can this be prevented? The small boy will prevent it by coating the bubbles with soap—that is, by toughening the liquid film. This then is the secret of "the froth-forming material" so frequently mentioned in the various patent papers of the Minerals Separation company. Why is an oil the most useful substance with which to do this?

It has been shown above that metallic particles are readily coated with oil. Therefore, an oil may not only toughen the bubbles but a cohesive force is exerted on the oil-coated metallic particles. Besides an envelope to hold the gas, an aeronaut uses a net to strengthen his balloon, so that when the pressure is relieved by the higher atmosphere it will not burst. This same effect is obtained in froth-flotation. In the same way that particles form around drops of water on a dusty floor and prevent the globule from breaking, small particles form a network around the large bubbles. This is due not only to the force of cohesion of the oil on one particle for that on another, but the force of cohesion existing between the particles themselves. Thus a froth is formed of bubbles that do not readily break.

It is a well-known fact that water has the greatest surface tension of all liquids under ordinary conditions, except mercury. It is therefore a safe assumption that dilution with another liquid will decrease the surface tension. The tendency to float is decreased. With reduced surface tension bubbles burst more readily. From this it is easily seen that surface tension is decreased exceedingly by the use of a volatile liquid. Alcohol evaporating from a substance held near a bubble will diffuse sufficiently to readily dilute the surface film and quickly burst it. Mineral particles floated when, for instance, amygdaloidal or globulous eucalyptus oil is used will dance on the surface of the liquid, being apparently attracted and repelled until evaporation has progressed sufficiently to equalize the surface tension not only of the liquid but of the bubbles as well.

Water then is the natural and universal medium for all flotation machines and air the necessary adjunct. The air may be in the pores of the mineral particles and as films around them, so that they are not easily wetted, in which case the machine may take some such form as a Macquisten tube or Henry E. Wood type—a purely surface-tension effect into which enters nothing but water and air. The meniscus of the water buoys up the metallic particles surrounded with an air film that prevents them being wetted. The force of gravity is less than that of surface tension, so the particles float. If the particles be surrounded by a water-film, the cohesion of the molecules of this film for those of the body of water neutralizes the surface tension, and gravity sinks the particles. Or again, minute bubbles may be attached to metallic particles that necessarily contain occluded gas. A thin film of oil may enclose or contain the particles and their attached bubbles. With sufficient displacement the particles will rise to the surface and form what may be termed a DeBavay float. Or, lastly, the bubbles may be large and have the mineral particles attached to them, as well as being attached to each other. This is the so-called froth flotation.

Concentration at the Tonopah-Belmont mill is 0.67% by weight, and 11.5% in extraction of silver and gold. An analysis of the concentrate is as follows:

S	31.6	Mn	1.1
Insoluble	30.6	Cu	0.6
Fe	29.8	As	1.6
Pb	1.3	Al_2O_3	0.42
Zn	0.6	Undetermined	1.57
CaO	0.8		
		Total	100.00

In the last financial year this product assayed 446.05 oz. silver and 2.368 oz. gold per ton.

Brass is a copper-zinc alloy containing over 50% copper. When a third metal, such as tin, is added, the mixture is then called 'tin-brass.'

Regulations for Metal Mines

A publication of considerable interest to the metal-mining districts of the United States has just been issued by the Bureau of Mines, under the title, 'Rules and Regulations for Metal Mines.' It is to be known as Bulletin 75 of the Bureau of Mines, the authors are W. R. Ingalls, J. Parke Channing, James Douglas, James R. Finlay, and John Hays Hammond. This committee was originally appointed at a meeting of the American Mining Congress at Denver, Colorado, in November, 1906, and its object was the drafting of a modern law governing quarrying and metalliferous mining which could be recommended to the several States for adoption, in the hope that the passage of such a uniform law by the mining States would tend to lower the number of fatal and serious accidents.

When the committee took up its work, it found that Colorado, Missouri, Montana, and New York were the only states that had enacted mining laws of broad scope applicable to other than coal mines. California, Arizona, Idaho, Kansas, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Oregon, South Dakota, Tennessee, Utah, Washington, and Wyoming, were found to have statutes pertaining to metalliferous mining, but with few and incomplete safety provisions.

This committee of the American Mining Congress did considerable work along this line and made a number of reports. In April, 1911, Joseph A. Holmes, Director of the Bureau of Mines, invited the committee to serve as a committee of that bureau with the idea of preparing a final draft of a law and this was accepted.

Starting with a composite of existing laws, the committee by successive stages endeavored to work out a general law that would embody the best mining thought of the day, be in accord with approved modern mining practices, and yet at the same time be effective and practical in operation, and not merely a collection of rules and regulations to be disregarded or enforced at will.

The committee in discussing its report says: "We have found that a great deal of interest and attention among mine operators has been awakened by our advocacy of improved means for promoting safety in mining. However, we are under no illusion that our recommendations will be immediately and generally adopted. We consider our work to be especially of educational character rather than anything else. It will be useful in three main ways, we think, as follows:

1. As a basis for State legislation.
2. As a basis for private systems of inspection.
3. As a collection of simple rules for the guidance of everybody engaged in mining.

"Since the publication of our first report several States have adopted new mining laws and amended their old ones. In this connection our code has served some purpose; for example, in the drafting of the laws that now stand on the books of the States of Nevada and Arizona. We do not expect that any State will at once adopt all of our recommendations, especially those that are essentially of legal character. We offer them as what we think ought to be and hope some day will be.

"Since our first publication, furthermore, most of the mining companies of consequence have adopted inspection systems or have at least framed codes of safety rules, which have been based to a large extent on our code, notably so in the case of the Cleveland-Cliffs Iron Co. This tendency, in fact, has become one of the most important phases in the national movement for 'Safety First.' This is the gratifying consummation that we had in mind. Unquestionably, also, the widespread adoption of State laws providing compensation for injured workmen has helped the safety movement by making accident prevention worth while.

"We consider, however, that the chief usefulness of the code of rules that we have formulated will be to small operators, who frequently engage in unsafe practices without knowing that they are unsafe or without thinking about the matter at all. There is a reasonable hope that our report will be of educational value to all mining operators.

"The act that we have drafted may be regarded from two angles—from the legal and from the technical. With respect to the latter we have had in mind the conditions and practice of mining existing and prevailing in the several parts of the United States. In our treatment of the matter from the legal standpoint, in which we have had the advice of good lawyers, we have refused to clothe the inspector of mines with the optional powers that are given to him under the laws of many of the British colonies, and, also, we have refused to convey to him the sweeping power that is given to health inspectors in some of our own States.

"The code of mining rules that has been finally drafted by the committee is the co-ordination of the experiences, opinions, and suggestions of a great many men who have assisted the committee in an advisory capacity and as directly employed aids. The former have included many engineers actively engaged in practice, members of professional societies, and members of the bar; the latter have included members of the regular staff of the Bureau of Mines and of the personal staffs of members of the committee. The committee has sought to obtain many points of view and to summarize many experiences. The draft that has been prepared is not offered as the last word upon this subject. There are many phases of this subject with which the committee has been unable to deal thoroughly. Thus the committee confesses its inability to formulate at the present time adequate rules covering the important subject of ventilation of mines. Similarly there are many practices in open-cut mining, by steam-shovels, etc., regarding which the committee has felt unable to formulate rules. We feel, however, that the rules so far as prescribed may advantageously be applied to open mining whether it be simple quarrying or the extraction of metalliferous mineral, as well as to underground mining."

Ore Dressing on the Mother Lode

By E. S. PETTIS*

An article by M. W. von Bernewitz in your issue of January 3, 1914, fully describes the metallurgical practice along the California Mother Lode. He speaks of a general impression that ore treatment in this region is sadly behind the times, though he found the contrary to be true at the time of his visit there. A. H. Martin mentions the fact that "California metallurgists have been most conservative in adopting methods developed by operators in other fields." We hear from many sources that modern ore-dressing methods are not to be seen on the Lode in contrast with the improved schemes adopted elsewhere. This may have been true formerly, but it does not hold good today.

An engineer visiting Amador county will learn that premature precipitation occurring during treatment, but is also due to the fact that this particular variety of slate is naturally the refractory part of the ore and the gold is not readily soluble in cyanide solution.

The ores from different mines vary in character, of course; this is perhaps not so noticeable in their appearance as in their amenability to treatment. It is most evident in the cyanidation of the concentrate. In some cases as much as 95% of the gold may be extracted by direct treatment and fine grinding, and in other cases less than 75%. A 90% extraction is claimed at a recently constructed mill, and large-scale tests indicate that a high extraction can be obtained by careful size reduction, amalgamation, and concentration, without re-

A TYPICAL MILL ON THE MOTHER LODE.

W. E. Darrow has been most progressive in the treatment of slime by concentration. The Darrow-Hambric slime concentrator produces a low-grade concentrate amenable to cyanidation with a fair extraction. This seems to be the best method available for treating the slime produced from the slaty ores of this district, and I venture to say that this will remain the prevailing scheme of treating the so-called float slime for some time to come. The oil-flotation process may possibly be adopted in the larger mills, but this is doubtful, and direct cyanidation has so far not shown satisfactory results, giving about 50% extraction. The poor extraction by ordinary methods of cyanidation is not entirely due to the reaction commonly called re-precipitation, which is sorting to fine grinding or canvas-plant treatment. However, the average extraction in the various mills is about 85%.

I remember, when passing through Salt Lake in 1907, the criticisms aimed at the wholesale use of stamps in Nevada and California, and we (on the outside) are still talking more determinedly than ever about "the passing of the stamp-mill." Here I make special mention of a new stamp-mill in the Grass Valley district where cyanidation follows amalgamation and concentration. It seems that the noise of the stamp-battery will still remain with us, much to the dissatisfaction of operators, though we all admit that the roar of the stamp-mill from a distance is music to the ear and a proclamation of productiveness.

*Metallurgist, Mill Valley, California.

We must bear in mind that the stamp-battery, essentially a quartz mill, has been performing its duty on the Lode and elsewhere as a gold-saving device as well as a crushing machine, and no other device seems to be equal to the double duty. The uniqueness of the stamp is that you can make it do the work of the rock-crusher and of the fine-grinding machine combined. This is typical of California practice, with amalgamation in the mortar as the main argument. Perhaps this is the cause of associating amalgamation with ore-dressing rather than with metallurgy.

The Plymouth mill was the first to deviate from old practice, although this mill cannot be taken as the model for the new metallurgy; still it is a step in the right direction and promises excellent results. In his article on this subject Mr. Caetani* has not emphasized emphatically enough the value of stage-crushing and classification of the general run of Mother Lode ores. I need only refer to the persistence of the canvas plant. I believe his contention correct regarding the danger of enriching the colloids by excessive sliming of mineral through fine-grinding in one operation, as with the stamp-battery. Surface tension of the water plays an important part in the floating of excessively ground sulphides and the oily nature of the slaty slime increases the float losses. An exceedingly dilute pulp is required to separate the fine sulphides by settling. This is the reason for the development of the automatic Darrow deck tables.

There is one advantage of classification that is not often mentioned, but appeals to the practical operator of the small mill and is not evident in the older California mill. That is, the concentrator department should be operated separately from the crushing department; and the classifier seems to perform this function, inasmuch as the classifier and dewaterer practically insure the non-interference with good concentration by variation of feed and water ratio in the crushing department. When the battery-man can use all the water he wishes without interfering with good concentration, the stamp-mill can be brought to its maximum crushing efficiency. It has been my experience in operating concentrators on unclassified material that the irregular ratio of feed to water continually occurring in the stamp-mill, due mainly to the occasional avalanche of fine ore from the mill-bin into the stamp-mortar, materially interferes with good concentration. The real value of classifiers and dewaterers is not for better concentration alone, but for the purpose of enabling the use of more water in the stamp-battery to lessen the excessive sliming of free mineral, the use of a finer screen, and the maintaining of the economical tonnage. Where dewatering is desirable, a classifier is advisable at 20-mesh to separate the sand and slime for slime-thickening and better extraction by economical concentration. Thickening-cones are considered necessary at nearly all up-to-date plants to precede slime concentration, but you see no such apparatus on the Lode, even where the total extraction is obtained by ore-dressing methods.

It might be interesting to recall an extreme case in the treatment of an ore once considered refractory. The following results were obtained by actual mill-runs at a 20-stamp mill in Tuolumne county. The plant has been converted into a direct-cyaniding and all-sliming plant, and has given excellent results on quartz ore.

MILL-RUN No. 1

The stamps dropped 105 per minute; 4½-in. drop; 6-in. discharge; crushing through 60-mesh; water ratio, 5:1; inclination of plates, 2 in. per foot; stamp-duty, 1.5 tons.

Twenty 850-lb. stamps, seven 4-ft. vanners, and canvas-plant; unclassified concentration; 1205 tons.

Ore heading $10.40

	%
Amalgamation	40
Vanner concentration	9
Canvas concentration	13
Total	62

MILL-RUN No. 2

Stamps dropped 83 per minute; 7-in. drop; 7-in. discharge; 60-mesh; water-ratio, 10:1; grade of plates, 1⅜ in. per foot; stamp-duty, 1.6 tons.

Sizing:

	%
— 60 + 100-mesh	30
+ 150 "	10
+ 200 "	8
— 200 "	52

Classification into three products: Coarse sand, fine sand, and slime, 445 tons.

*Ore heading $6.49

	%
Amalgamation	37.0
Vanner concentration	15.2
Canvas concentration	12.3
Total	64.5

*The increased extraction was obtained from ore 40% less in value.

MILL-RUN No. 3

Stamps dropped 85 per minute; 7 to 8-in. drop; 8-in. discharge; 60-mesh screen; water-ratio, 8:1; grade of plates, 1½ in. per foot; stamp-duty, 1.8 tons; feeding finer ore to battery, 532 tons.

*Ore heading $8.69

	%
Amalgamation	42.5
Vanner concentration	19.1
Canvas concentration	8.2
Total	69.8

*20% lower-grade heading, concentrate of same value ($50 per ton) in all runs.

I was told at one of the plants where vanners are in use that unless careful plate-amalgamation preceded concentration, some of the fine amalgamable gold was lost, passing from the vanners with the tailing. I failed to observe as careful plate-amalgamation on the Lode as elsewhere, referring to mills in which the grade of plates is set at an inclination of 1¼ to 1½ in. per foot.

The California practice is to get the free gold as soon as possible, and in changing to the two-stage crushing method we are confronted with the problem of amalgam-

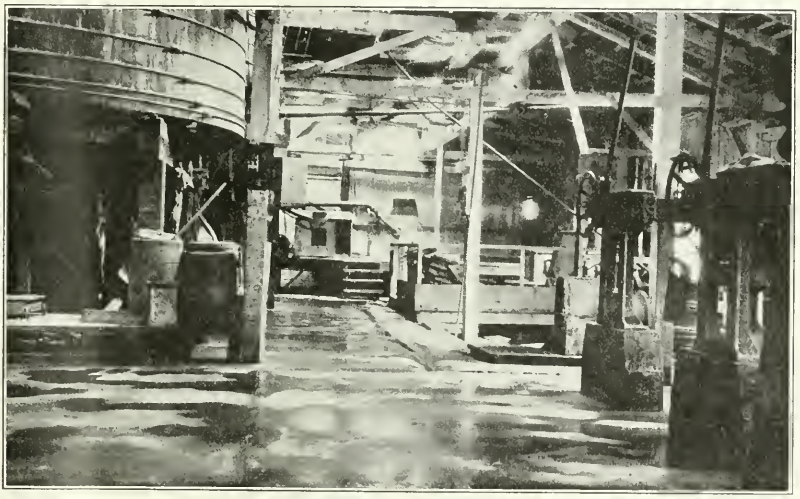
*"The Plymouth Mill," by Gelasio Caetani, MINING AND SCIENTIFIC PRESS, October 31, 1914.

ating the coarse gold as successfully as has been accomplished in the mortar of the stamp-battery.

In South Africa, plate amalgamation in the tube-mill circuit is advisable for extracting the coarse gold, but cyanidation follows, whereas in a concentrating plant the concentrator saves what the plate cannot, and in some cases the reverse.

In adopting the two-stage crushing of modern practice, why not eliminate this unnecessary amalgamation of coarse gold entirely before concentration, as has been done in many mills elsewhere, and employ the apparatus now used in amalgamating the concentrated material as it comes from the table? If it is true in any particular case that the concentrators lose fine gold that can be amalgamated, I believe in amalgamating a thin pulp after concentration and classification, passing the fine over plates of low inclination, obtaining the benefits of classification in plate-amalgamation as is the better practice in concentration.

Probably the most modern mill on the Mother Lode is at the Original Amador mine. This mill was described in the PRESS of June 19. The excess water used in stamping and classifying is clarified in a large thickening-tank, with subsequent concentration of the thickened slime on Deister tables. Cyanidation of the total concentrate is another addition, completing the process of local treatment. The Deister tables used throughout the plant are operated at high efficiency. As the concentrate can be treated locally, an increased extraction is possible by producing a so-called sandy concentrate. The most noticeable departure from ordinary Mother Lode practice is the elimination of extensive plate amalgamation before and after fine grinding. Some amalgamation of the coarse gold is attempted in the Hardinge amalgamator, and on short sluice-plates following. No provision was made for returning an oversize from the pebble-mills, as they have sufficient capacity to reduce the ore with one passage through the mill. I am told that the capacity of the whole plant is to be increased, and the pebble-mills operated with a return of an oversize. In this event there will be less sliming of the sulphides and less enriching of the slime, which is concentrated in a thickened condition. An equal extraction with increased tonnage will be the result. The pebble-mill, reducing to 40 or 60-mesh, seems to work at higher efficiency with some very coarse material in the circuit, and in feeding a pebble-mill product from a stamp-battery, instead of using, say, an 8-mesh screen with a low discharge to maintain a given tonnage, it is better to feed as uniform a product as possible. Therefore a 6-mesh screen and higher mortar-discharge is preferable, using water in proper quantity.



INTERIOR OF A CYANIDE PLANT.

[Mr. Pettis neglects to mention an essential feature of this mill, namely that the overflow from the concentrate-classifier is pumped to one 18-ft. diam. by 12-ft. deep treatment-vat, equipped with the Trent cyaniding apparatus. This vat, with a dilution of 70%, has a capacity of 30 tons of concentrate; and, when starting to grind a charge, the vat is filled with barren solution, the circulating pump started, and the valves set to operate as a thickener and replacer. Then the pulp from the classifier, having about 80% dilution, with about 50% of the gold dissolved during grinding, is pumped into a 12 by 12-in. box hung in the centre and submerged 3 ft.; and, while the charge is being ground and thickened in the bottom of the treatment-vat, the clear overflow, with a large proportion of the dissolved gold, overflows and goes to the sump-vat, which has a filter-bottom. After the charge is ground, and previous to agitation, about 50% of the solution in the treatment-vat is replaced with barren solution, and the valves on the vat changed to operate as an agitator. This is continued for six or

eight hours, after which all the recoverable gold is in solution. The valves are then changed on the treatment-vat so as to operate as a thickener and replacer, and about 10% in excess of the solution in the vat is replaced with barren solution, after which 20 tons of wash-water, carrying about 2 lb. alkalinity per ton is added, and the charge allowed to settle into the wash-water. The solution above the pulp is then decanted into the sump-vat and the pulp sluiced to waste.—Editor.]

In the testing-plant I have found that crushing in the stamp-battery to 8-mesh, screening through 20-mesh, and concentrating the 20-mesh undersize (representing about 45% by weight of the original ore), an extraction of 50%, or more, of the total content can be obtained from the general average of the Mother Lode ores. No appreciable amount of free mineral remains on 20-mesh.

Experimenting with a somewhat refractory ore containing perhaps a less proportion of slate than the average, about 10% slime was produced in stamping through 8-mesh. In this particular instance the ore was crushed through 8-mesh and concentrated, re-ground in the closed circuit of a continuous pebble-mill to 40-mesh, plate amalgamated, and concentrated unclassified. The ore assayed $4 per ton, and yielded 50% at the first 8-mesh concentration, 30% by plate-amalgamation of 8-mesh tailing re-ground to 40, and only 5% by final concentration. The slime portion, 10% of original feed from 8-mesh crushing was thickened and concentrated on a Deister table with the following results:

	Percentage by weight.	Assay.		Content, %
Heading	100	$3.20		100
Tailing	...	2.65		79.7
Concentrate	1.85	35.20		20.3
Extraction	...	0.65	or	20.3

Extraction per Original Feed

	Percentage by weight.	Assay.		Content, %
Heading	10.1	$3.20		7.95
Tailing	9.02	2.65		6.40
Concentrate	0.185	35.20		1.55
Extraction	....	0.065	or	1.55

The gold extraction from this first slime product by direct concentration is low even when exercising great care, and very little of the gold can be saved when endeavoring to concentrate on the same table with 20-mesh sand and an excess of water. The first slime produced by coarse stamping or wet crushing with balls should be eliminated from the bulk of sand and fine material before finer grinding, and treated separately. It is difficult to settle this slime to any degree of density, and the oily nature of the float slime (carbonaceous or otherwise), has a tendency to float the fine mineral when mixed with the re-ground sand. This is what happens in the single-stage crushing-apparatus. Apparently 60-mesh is the proper size for the second grinding for economical concentration or amalgamation of these ores, and to study the most efficient method of ore-dressing applicable to Mother Lode ores, one need only refer to modern methods used elsewhere in concentrating plants.

I understand that investigations are being made for a possible method of treating Mother Lode ores, especially by cyanidation, by the U. S. Bureau of Mines. This will probably prove to be a double-treatment method, on account of the precipitation of gold during dissolution. Still, when an extraction of 85 to 95% may be obtained by careful concentration and amalgamation from $3 to $6 ores at a milling cost of from 30 to 50c. per ton, it seems that energy should be exercised in developing more mines and economical crushing-plants for handling large tonnages.

Iron ore mined in the United States in 1914 was as follows, in long tons, according to the U. S. Geological Survey:

State	1914	1913
Minnesota	21,946,901	38,658,793
Michigan	10,796,200	12,841,093
Alabama	4,838,959	5,215,740
Wisconsin	886,512	1,018,272
New York	785,377	1,459,628
Pennsylvania	406,326	489,056
Virginia	378,520	483,843
Wyoming	366,962	537,111
New Jersey	350,135	325,305
Tennessee	330,214	370,002
New Mexico	81,980	164,085
Georgia	67,722	155,236
North Carolina	57,667	69,235
Missouri	37,544	39,354
Kentucky	21,400	3,400
Utah	(*)	14,690
Colorado	10,464	(*)
Connecticut	9,149	(*)
Massachusetts	7,600	(*)
West Virginia	6,530	7,808
Maryland	6,369	(*)
Ohio	5,138	7,849
Montana	(*)	2,475
California	1,282	2,092
Other States†	40,800	115,370
	41,439,761	61,980,437

*Included in Other States.

†In 1913: Colorado, Connecticut, Idaho, Maryland, Massachusetts, Mississippi, Nevada, and Texas. In 1914: Idaho, Mississippi, Montana, Nevada, and Utah.

Pig-iron production was 23,332,244 tons, a decrease of 24.65%. The quantity marketed was worth $71,905,079.

Graphite. In his work, entitled 'Les Richesses Minérales de Madagascar' (published in 1912 by Dunod et Pinat, Paris), D. Levat states that on the island of Madagascar, the graphitic gneisses form a belt of 40 kilometres radius surrounding Tananarive. The natives work exclusively on the decomposed outcrops which are easily handled with pick and shovel without explosives. This decomposed material contains approximately 10% graphite in disseminated scales, but owing to their crude methods it takes 20 tons of it to produce one ton of graphite.

Lime production of the United States in 1914 amounted to 3,380,928 short tons, worth $13,247,676. There were 954 plants operated, a decrease of 79.

Geology as an Aid to Tropical Engineering

By WARREN D. SMITH*

Introduction. The purpose of the present paper is to discuss, first, the general geologic processes as they are found at work in the Tropics, contrasting their effects with the same processes in the Temperate regions of the earth, and second, to cite some examples showing their practical bearing upon the engineering problems arising in those regions.

From many years of contact with engineers and their problems, particularly in the case of Tropical countries, I know that often all too little attention is paid by the engineer to the fundamental considerations upon which geology alone is capable of throwing light. This is due frequently to a deficiency of and lack of breadth of training. How is it to be overcome? It is hardly to be expected that the engineer-student will be able to put any more geology into his already crowded courses. That, however, is not necessary, for all that is desired is that he realize his limitations and the importance of the bearing of geology upon his work and the need for expert advice. Some engineers in the Philippines with whom I have had the pleasure of working showed that they appreciated this fully. Others did not, and as a consequence they have left monuments to their lack of insight.

Previous to our experience in the Philippines and Panama, we Americans had had no especial contact with the Tropics and consequently many of our engineering data were found untrustworthy when applied to wholly new and unusual conditions. An especially good example may be cited in the location of our highways and railroads. In the United States, we run a railroad line up one canyon over the pass and down the other side by way of another canyon. This has been tried in the Philippines, notably in the Benguet road; the result is that this road will have to be abandoned because of excessive cost of maintenance. In the Tropics, during high water there is room for but one thing in a valley and that is the stream which occupies it; such a feat of engineering as that which has made the Royal Gorge and the Denver & Rio Grande railroad famous is absolutely out of the question.

There is one cardinal rule to be laid down at the outset, namely, take nothing for granted, investigate each problem separately. Handbooks and set formulae are worse than useless; they are dangerous.

I wish to compliment Professors Ries and Watson for giving us their admirable work on 'Engineering Geology.' This book, good as it is, however, does not help us much in the special field we are considering; therefore, I offer this contribution to the subject. There is one other book on this same general subject, by Sorsbie, which I am frank to say was a disappointment to me as it contains little that is either new or specific.

The general topics considered in the following paper have already been broached by me in an article contributed to the Proceedings of the Philippine Society of Engineers and I am indebted to members of that society for many data and much inspiration. The United States may well be proud of her young engineers in the Philippines. Their work may have been less spectacular than the digging of the Panama Canal but political, social, and racial factors have made the Philippine job no less difficult.

Geological Agents. The three most important geological agents are:

1. Diastrophism.
2. Vulcanism.
3. Gradation.
   - Weathering.
   - Transportation.
   - Corrasion.
   - Corrosion.

1. Diastrophism. This denotes up-and-down movements in the crust of the earth. Such movements are negligible apparently in the older and more stable parts of the earth, but, even there, they manifest themselves as earthquakes. In the newer parts of the earth and particularly along continental borders they are of great magnitude and importance. As it happens, many of those places are in the Tropics. This is true of both Panama and the Philippines. At least once and perhaps twice before, the barrier of the Isthmus of Panama, which has cost so much in life, labor, and money to cut through, has been overcome by the intermingling waters of the Atlantic and the Pacific and it is not at all impossible that future diastrophic activity will make all our labor useless. However, these movements are so slow as to be almost negligible in any one generation. Only the geodesist finds that he has to readjust some of his calculations.

2. Vulcanism.

As the Philippine archipelago is a part of the so-called Circle of Fire that girts the Pacific Ocean, we naturally expect the vulcanism to be of such magnitude that the engineers would have to be continually anxious. Nevertheless, except for those regions in the immediate vicinity of active volcanoes, little damage has ever been recorded from this cause. The most marked effects were those noted in 1911 resulting from the explosive eruption of the Taal volcano, situated about 25 miles due south of Manila. Had there been a large city the size of Kingston, Jamaica, for example, situated on the shores

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of Lake Bombon much damage might have been done. The town of Lemery, only a few miles distant, suffered to the extent that an old church made of volcanic tuff was badly disfigured and a triangular section of land, crossed by one of the Government's new highways, dropped about three feet, allowing the tide to come inland for perhaps a half mile. The length of damaged road amounted to about two miles. These effects were due directly to earthquakes and indirectly to the volcano. Although 498 distinct shocks were recorded in Manila, at the time of the eruption practically no damage was noted. The claims of a certain American firm, with a patent type of concrete construction, that none of their buildings had suffered any damage at the time were strictly correct, for no buildings in Manila revealed any weakness.

Another instance in which vulcanism did play an important part was that in which a section of road in one of the provinces was obliterated for a distance of two or three miles by a fall of bombs and a deluge of mud and ashes from the Mayon volcano in 1902.

3. Gradation.

This is the sum total of the wearing-down process—in many respects the dominant geological agency. If we analyze this process we find that the following agents are contributory: a. Weathering; b. Transportation; c. Corrosion; d. Corrasion. I would, however, make 'corrosion' a sub-heading under weathering, there being two factors involved in weathering, a mechanical deformation, and a chemical change, either of which may precede the other. Then once weathering, or, to use a very crude term defining it in part only, 'sleeking' has taken place, transportation comes in and does its work and then 'corrosion' or mechanical wear becomes operative, but not until there is movement.

Of course, these factors are operative in all countries and under nearly all conditions, but gradation probably proceeds at a maximum rate in the Tropics. Two reasons are given for this, namely, rainfall and temperature, or in one word, climate.

In the Philippines we have a mean annual rainfall of over 100 inches, with sometimes exceptional and almost unprecedented precipitation, notably 72 in. in 56 hours on July 29, 1911, at Baguio Observatory, P. I. This record is second only to that recorded at Simla, India.* At such times the streams leave their banks and spread out over the country in sheets of water. Needless to say, the amount of material then transported is almost incalculable. Furthermore we have another factor to consider, namely, the factor of velocity. Often this is not taken into consideration. When we stop to consider that doubling the velocity of a stream means increasing its transportation power 64 times, we realize what a power we are trying to combat. We shall return to this topic.

Once the tropical downpour of warm rain has stripped off the soil, weathering can and does strike deeper into the core of rocks beneath and however far we go underground in mine workings we find the rocks exhibiting incipient decomposition. I know this to be true from the examination of a great many thin sections of wall-rock from the deepest mines in the Archipelago. Undoubtedly the presence of organic acids, resulting from the decay of the rank tropical vegetation, hastens this decomposition. Of course, we have little or no frost, except on the highest mountains, but we do have wide ranges in temperature during the 24 hours and this adds to the disintegrating forces at work. And so all things considered, we have reason to think that gradation is the most potent of the geologic processes at work in the Tropics.

Special Problems. Road-building and maintenance. In the Tropics and particularly the Malay region, the seasons are sharply defined, one of practically no rain and one during which it rains in torrents. If we recall the rule that the carrying power of a stream varies as the sixth power of its velocity, we know at once we cannot take any chances with a tropical torrent. In regions of high relief we have four things to consider and we cannot neglect any one of them. They are:

1. Declivity or head.
2. Sudden increase of volume due to configuration of the valleys.
3. The angle of slope of valley-walls.
4. Material and structure of the valley-walls.

I have seen highways placed in valleys at such points that the road was continually menaced by the stream just below it and by the sliding of material from the slopes above. The stream is dangerous because of two things:

First; the sapping of the water itself.

Second; when the velocity is doubled it can carry particles of rock 64 times as large as before; and in time of freshets, boulders weighing tons are carried along, each one acting as a battering ram. No retaining-wall can be expected to, nor does, withstand this terrific bombardment.

Again, the composition of the country-rock, its structure, texture, and the state of weathering are of vital importance. If the weathering extends to a considerable depth, it will be an easy matter to start slides (witness the Culebra Cut at Panama), and if this weatthered material slides into the canyon below, a temporary and very dangerous dam results. When the dam breaks, and it soon must with the impounding of the torrent behind it, all will be swept before it. We have a remarkable example of this in the now famous Benguet road on the island of Luzon. The Bued river is a small stream, little more than a creek in the dry season; it flows from 5000 ft. elevation to the sea. The valley-walls are V-shaped, the average slope being probably as high as 35° or even 40°. The country-rock is a badly decomposed andesite for the most part with some tuff deposits, much jointed and with innumerable small faults, all loosened by many earthquakes. Here we have ideal conditions of instability, which were perfectly ap-

*[These rainfalls are remarkable, but are quite drowned by that of Cherrapongee, in Assam, where an annual deluge of 900 inches is recorded.—Editor.]

parent to geologists, yet as far as I know, no geologist was consulted by the engineers until it was too late. The inevitable happened. First, slides continued until the slopes reached the angle of repose; then dams followed, impounding the water to a great depth; next, the dam broke and search parties were out looking for the road, buried under sixty feet of debris. Now after many years and spending much money, the road is to be abandoned. And so they are going back to the ridges, following the example of the Spaniards.

On the question of the engineering technique involved in the construction of these roads, I would venture to lay emphasis on the necessity for drainage—keep the foundation of your road drained. You may say that this is nothing new, that every engineer knows that, but the application in America where the rainfall is merely a light summer-shower as compared with the tropical downpour is a different problem. As to how it should be drained, that is not within my province as a geologist.

Maintenance on a road constructed of poor materials is one thing while that on a road wherein a wise selection of metal has been the rule is an entirely different thing. Right here a geologist with his microscope is a necessity. Petrography, once despised as an academic study, is now indispensable to the scientific road-builder. There is a pathology of rock just as there is a pathology of animal tissue. The microscope will reveal at once, and at little expence, whether or not the minerals composing the rock are sound, whether there is incipient decomposition, or a far-gone state of decay. It will show also the fabric or texture of the rock. If the rock has an ophitic texture, that is, the minerals interlaced to make up a sort of mat, then we may look for toughness. Why one rock splinters and another does not, or why one crumbles rapidly into a powder, is at once made clear.

At one time I collected rock-specimens from a number of places along one of the principal Philippine highways and among the samples was one that yielded a briquet which when placed in the De Laval cementation machine refused to break under 2000 blows, whereas an ordinary basalt briquet yielded at the 22nd blow. A thin section of the fresh rock was made and examination showed that there was a small amount of secondary calcite in the rock, an alteration-product of the lime-bearing silicates; it was this that furnished the excellent binding qualities. The rock was a diorite just beginning to decompose without having gone so far as to reveal this condition to the naked eye. This rock, with its holocrystalline texture and just the right amount of calcite, would make a most excellent road-metal because it had two essential qualities, namely, toughness and high cementation quality. Of course, the objection of high cost will be raised at once; but no matter how the finances stand, there is never any excuse for putting worthless and unsuitable rock on a road. My plan is this, let the geologist recommend one or more kinds of material and then let the engineer consider which he can afford to use.

I am glad to state that that is the way the Philippine Government is doing things, for the advice of the geologist is always considered nowadays by the engineers of the Bureau of Public Works. The Bureau of Science maintains a road-testing laboratory.

A VALLEY IN THE HIGHLANDS OF LUZON.

Artesian Water. The principles governing the concentration and movement of ground-water are now well understood, but, at the risk of repetition, I shall make a few general statements.

First: Although we do not see it, the sea of underground water is almost as extensive and in some ways more important than the ocean. All the rocks, varying in degree of saturation, contain water down to a limiting depth. Some of this water is found in the large trunk-channels, joints, and faults, but a great deal of it is in the form of hygroscopic water, that is, water held in the pores of the rock by capillary attraction. Some rocks, like the dense volcanic flows and quartzites, contain practically no water. Other rocks, like the limestone formations, have subterranean rivers passing through them, but the sandstones and chalks are the most important in this respect. A true sandstone consists of grains of quartz compacted together. The more nearly spherical these grains are, the more continuous are the openings. In such an arrangement of spherical grains there is always a continuous passage through the mass. Along this passage the water travels. Some sandstones have as much as 35% of pore space.

An English geologist, H. B. Woodward, makes the statement that the quantity of water held in the chalk of England by capillary attraction is tremendous. One square mile of dry upper chalk, one yard in thickness, contains nearly 3,500,000 gallons of water, and when saturated holds 200,000,000 gallons.

The loose volcanic tuff formations of the Philippines are also great water-carrying formations. This water is generally circulating slowly in the small openings, but when the water reaches a fissure, naturally the circulation is rapid.

Let us consider the best condition for artesian water. As the deep-seated igneous rocks are usually dense and have but little pore space, and as the fractures of this formation have no regularity, it can be seen at once that this is a poor formation in which to seek water. Water may be traveling along a fissure in this formation, and the well-digger may pechance strike this fissure, but usually the chances are slim. There is no excuse for locating a well in such a formation. A limestone formation is also poor, for while it is cavernous and contains underground streams, it is a pure piece of luck when one of these is struck. The best conditions are found in the sandstone, volcanic tuffs, and beds of unconsolidated ash. Having found the formation, we must next consider some features in the structure of the region. The ideal condition is where the sediments form a syncline (basin) with the water-bearing stratum outcropping at a higher point than the site of the well and where there is an impervious layer of clay or shale just above the water-bearing stratum. The effect of a fault on the water circulation would be to divert the flow to springs at the outcrop, but the effect of an igneous intrusion would be to block the water circulation. All of these things must be examined, if possible, previous to the digging of the well.

It is incredible that even at this late day water should be sought with a divining rod, yet in 1907 an attempt was made to find artesian water with a divining rod in the city of Zamboanga (Mindanao). Water was not found, and an examination of the geology of the country showed that very little chance existed of a supply being tapped within a reasonable depth. In spite of one or two apparently plausible features about the divining rod, the use of this device may be classed with other pseudo-scientific operations such as palmistry and astrology. Besides this case of the Zamboanga well, there is one on record in California where a man spent about $25,000 trying to get a well in a semi-arid district. He never did get water, and a geological examination of the country revealed the fact that a fault in the neighborhood precluded utterly the possibility of water being found in that part of the formation in which he was drilling.

Three or four years ago at Olongapo, Luzon, a well was drilled on the naval reservation, and when I visited the place I examined the cuttings in the drill and found the material to be diorite, which is the basal formation of the island and contains very little water, having no regular continuous water-passages. The well-digger drilled here for 22 months. No water was found, and in the end he lost all his tools in the hole. As the driller was paid by the foot, he, of course, did not have to pay the bill. On the island of Guimaras the same thing has recently been done. In another part of the Islands a well was dug and the water was found to be brackish. An examination was made of the locality, and it was found that the stratum which had been tapped outcropped a short distance away in salt water.

The Bureau of Public Works, I believe, has paid more regard to the geology of the country than any other engineering organization here; and, so far as its wells have been dug in the Manila central plain, good results have been obtained. But I wish to emphasize this fact, that in spite of all the practical experience of a well-driller, there are many more things to be taken into consideration than simply those that pertain to digging the well. The instances in all parts of the world of unwarrantable waste of money are so numerous as to prove that the practical well-driller is not the one to locate a well—he is often thoroughly unpractical. At the present time a special expedition of five geologists and two topographers is at work in Patagonia,† loaned by the United States to the Argentine republic, for the purpose of choosing favorable artesian-well sites for the Government.

The question of health enters largely into the location of wells. It is important to know the structure of the country in order that one may know the direction of drainage and whether or not pollution of the underground streams does or does not exist.

†[We are informed that this expedition found no artesian basins possible; hence, geology was of negative value. But, with American resourcefulness, the expedition turned its attention to topographical and hydraulic engineering; after much hard labor, a supply of water was found in a river that had not been considered previously because it was supposed to flow at too low an altitude.—Editor.]

I am told that in certain parts of the Hawaiian islands water has been found by sinking through the overlying formation, largely consisting of lava, to the ash-beds that lie buried below. The water here is ponded in this loose formation by the coral reef bordering many parts of the islands. The same conditions, no doubt, could be found in many parts of the Philippines.

It is time that there should be some good wells in crystalline rocks, but, as Ries and Watson bring out in their diagrams, the chances of striking a joint or fault carrying water is much less in these compact rocks than in a formation every void of which is saturated with water.

Dams and Reservoirs. The geological conditions affording the best sites for dams and reservoirs have also been covered by Ries and Watson. With reference to this phase of the subject I wish to state that a geological examination of a district and several years of stream-gauging is not only desirable but imperative in the Tropics. I could cite many examples of how these works should not be located, but two or three will suffice. The city reservoir at Montalban was made in a limestone gorge. The limestone is full of caverns and the reservoir failed to hold water until it was lined, bottom and sides, with cement. If the dam had been placed at the upper end of the gorge the reservoir would have had a natural clay bottom.

The destruction of the Tarlac (Luzon) dam probably could not have been foreseen, but if a few more data concerning annual precipitation and stream-discharge had been secured the trouble might have been averted. The Agno river when under full head is a terrible engine of destruction. A dam was built in the hills back of Cebu making use of an apparently substantial formation for abutments and spillway. Drilling was recommended by the geologist who examined it; but no, that would be too expensive. The abutments held in a terrific storm that ensued, but the spillway, which was too small, forced the water to eat its way down through a decomposed formation which had a hard shell on the outside, so that the dam was useless.

From my observations in the Philippines, I should be inclined to say *never* build a reservoir in the Tropics. If water is needed use diversion weirs in streams or else artesian wells.

Coal Mining. I had intended not to touch on any phase of the application of geology to mining engineering in this article for the reason that the connection between the two is so generally recognized. There is just one point that should not be overlooked here, and it is one that has given more or less trouble to those who would work coal seams in the Far-Eastern Tropics. It has been my experience throughout many years of examination of coal prospects and mines in the Tropics that the persistence of a given seam of coal is always a matter of conjecture. They often thin or 'peter out' just when you are counting on a good working thickness. I have long sought for a geological reason for this and have at last worked out these tentative conclusions:

THE RESULT OF TORRENTIAL WASH, IN THE PHILIPPINES.

1. We have great rainfall over most of Malaya today. There is every reason to suppose that this has been the case throughout most of the Tertiary period, which is the age of the tropical Malayan coal.

2. The great deluging downpours of rain mean coarse sedimentation and frequent interruptions to the quiet accumulation of vegetal matter from which we are to hope for a future coal deposit. We do find that the character of the underlying and overlying beds in the neighborhood of these uncertain coal-beds is very variable, coarse and fine strata alternate with no great thickness to any one stratum. So my advice to the engineer or geologist who is sent out to examine a coal deposit in any part

of the Tropics is this: examine carefully the nature of the enclosing strata, the character of the grains, size, and arrangement, and take nothing for granted, put down test-holes or drill everywhere in the field, and, better still, drive on your coal.

Geodesy. Over fifty years ago there appeared in the Transactions of the Royal Society several articles by the learned Bishop of Calcutta, a mathematician and physicist of no mean repute, relating to the perplexities then confronting the surveyors in control of the great Topographic Survey of India. This, one of the greatest of surveys, is still in progress. The problem that confronted them was how to account and allow for a very noticeable and very important discrepancy between the trigonometrically located stations and those ascertained by astronomical determinations. To cut the matter short, the trouble was found to be in the deflection of the plumb-bob due to the mass of the Himalaya mountains.

In the course of the coast survey of the Philippine islands, it has been found that there are frequently large discrepancies between the location of the trigonometrical stations and the astronomical stations. This has amounted, in some places, to 30 or 40 seconds of arc, which may mean a matter of half a mile or more on the surface of the earth. How to adjust this has been a matter of some difficulty. The great piles of volcanic rock constituting the Zambales mountains are adequate to explain the discrepancies at some of the stations on the west coast of Luzon. But, at Olongapo, it was found that the plumb-line instead of being deflected to the east was deflected to the west, though the main mass of the Zambales mountains lies to the east. An examination made by me several years ago of the Cinco Picos range, which lies to the west of Olongapo, revealed the fact that these mountains are made up of one of the densest rocks known, the rock called peridotite. This rock has a density of over 3, whereas the main mass of the rock in Zambales has a density only of about 2.5. Therefore, apparently, this discrepancy is explained by our knowledge of the geological features of the two regions.

Seismology. Earthquakes are not confined to the Tropics. Nevertheless, the regions of greatest seismic disturbance are either within the Tropics or not many degrees removed. I do not know that there is any connection between these facts. It happens that the newer (geologically) parts of the earth are for the most part within this zone. In view of the great engineering works built at Panama, in the Hawaiian islands, the Philippines, and elsewhere, it is of importance to understand the principles controlling earthquake phenomena.

In an investigation conducted for many years by Father Masó of the Philippine Weather Bureau and myself, we found that of the great number of earthquakes in the Philippines from 1599 to 1909, only a comparatively small number could be traced to volcanoes, and that of the 25 seismic districts in the Philippine islands, only five are near or include active or dormant volcanoes, and the two regions of greatest seismicity had no volcanoes at all.

The damage done at San Francisco by earthquakes, the catastrophes of Messina and Avezzano, and the lesser disasters that have overtaken the Philippines from time to time, all force us to pull our heads out of the sand and look facts squarely in the face. Of course, a great deal can be done to minimize these destructive occurrences by proper construction.

There are two things we must do to cope with earthquakes; in the future we shall in all probability do much more—perhaps predict, as is indicated by Perrett's work.

First, build structures completely tied together, whether of bamboo (the best type), wood, or concrete. My preference is for sand-lime brick securely tied to a steel frame.

Second, we must map the geology so as to show all formations, contact lines, and faults.

We may be able some day, if we study these things under the guidance of Montessus de Balore and Perrett, to see a people living in comparative security enjoying unafraid the fruits of husbandry in an earthquake region.

Physiographic Control of Economic Development. My last topic is quite different from any of those I have already discussed and does not permit of definite statement nor of exact proof. I shall attempt to show by the citation of three cases how a knowledge of the geologic and physiographic conditions would be beneficial in practical matters, aside from the more obvious applications to mining.

The island of Cebu in the Philippine group is long, narrow, and mountainous. It has an interrupted strip of coastal plan on which practically the entire population of the island may be found. The people are poor and live largely on and by the sea. There is no productive 'hinterland' or back country. Paralleling and for the most part within a few yards of the sea is a first-class macadam highway. With these conditions confronting them a railroad company constructs a third (steel) highway for the most part within a few yards of the first two. Had it not been for the Government guarantee of 40%, this venture would have been a great loss to the investors. The railway never had a chance of success and the guarantee is a conspicuous example of lack of business acumen on the part of the Government.

My second case is that of the now famous Benguet road, already mentioned. I have tried to show how a highway can run up a canyon in the Philippines and be permanent. Now the change of location for this artery of travel leaves a big section of the country stranded, but at the same time will tend to develop the other section through which the road will in the future run. In this particular case the coastal tract in the neighborhood of San Fernando de Union (west coast of Luzon) will receive a great impetus.

North of Lubig bay (about due west of Manila) there is no first-class typoon harbor on the coast of Luzon. This deficiency is reflected at once in the general character of the coast towns and cities all along this west and

north shore-line of Luzon. The same is true for a goodly portion of the east coast of the same island and again on the east coast of the great southern island of Mindanao.

I can give a practical example illustrating how this works out: The island Pollillo off the east coast of Luzon has some good coal seams—true bituminous coal—and there is a good harbor at Burdens on this island, but no harbor worthy of the mention anywhere near on the mainland (Luzon). Consequently scarcely any ships navigate these waters. Now we know pretty definitely from investigations made in Borneo that a coal mine in this part of the world must be able to sell most of its coal to passing ships in order to succeed. The coal cannot under existing conditions be shipped to Manila. So here we have the coal industry depending upon the amount of shipping on that coast and that in time dependent absolutely upon the nature of the coast and the population thereof, all of which go back to geologic and physiographic conditions. And so we see so-called practical business men making blunders like these because they refuse to consider as practical the advice of the scientific investigator.

The San Francisco Mint in August

Operations at this institution were interesting on account of the English and Japanese gold coins, and Chinese bars received, and the minting of $50 octagonal and round Exposition coins. The total gold received was worth $13,890,289.59, and 1,236,191.81 oz. silver valued at $600,330.82. The special coins amounted to $100,050, and others $115,350 (half dollars and one-cent pieces); also ₱5000 of bronze one-centavo pieces for the Philippines. Coin, bullion, etc., on hand at the end of the month totaled $310,549,174.78.

The Baggaley method of converting blast-furnace flue-dust into a commercial product is accomplished by passing molten iron direct from a furnace, ladle, or mixer in an even stream through a small swirl-basin and thence through a funnel 33 in. long, which extends from the bottom of the basin. A steady stream of dry, screened flue-dust is fed into the centre of the swirl-basin by means of a pipe which has a refractory lip. The lip is submerged in the molten metal to prevent the escape of flue-dust into the air. It is claimed that 4000 lb. of molten iron and 1000 lb. of dust can be passed through the basin and funnel per minute. Any number of basins may be used. The coke and limestone and a large portion of the silica are burned out of the dust, making it possible to return the remaining metal to the blast-furnace, where it can be re-melted at a minimum cost. With a 33-in. funnel, 500 lb. of dust may be treated per ton of iron.

Tin-plate (sheet-iron coated with tin) and terne-plate (sheet-iron coated with an alloy of tin and lead) consume only 20% of the total output of tin. Tin-plate ordinarily contains 2 to 3% of its weight in tin. While terne-plate contains about half this amount.

Mining in China

A prominent United States official who passed through San Francisco a few days ago stated that opportunities for the investment of capital in Chinese mines were excellent. China undoubtedly has rich mines that are not being properly worked, but the mining laws are such that no prudent foreigner will engage in mining. Mr. Loke Chow-Thye, a citizen of the Malay States, is quoted in the *Mining Journal* (London) as follows:

"I visited many mines and discussed numerous schemes with mine-owners and also Government officials, but after a year's work I find there are many obstacles in the way just now, and am returning home to the Straits Settlements a disappointed man. The chief difficulty is that the Chinese who obtain Government permits for mines seldom work the property to any extent, but use their permits to keep others out. If you inquire why they do not work on a larger scale, they invariably say that they are short of capital, but when you offer to provide capital it always occurs that when you get down to details you cannot get a reasonable offer. It seems to be an invariable belief of the mine-owners that because they have registered the property therefore the whole contents of the mines belong to them. They themselves cannot find capital to work it properly, but they expect you to find all the capital, take all the risks, and share half of the profits with them.

"If they have spent a few thousand taels in obtaining the Government permit and scratching the surface, they expect you to spend a few hundred thousands of taels on their property, and then, after taking all the risks, you might share half and half the profits. This attitude of the mine-owners has been brought about, I think, largely by the Government Mining Regulations, where (in Article IV) it is laid down that 'the shares taken up by foreign subjects shall not be allowed to exceed five-tenths of the whole share capital.' This would be all right if the Chinese mine-owner could raise one-half of the necessary capital, and agree to accept a reasonable number of shares for the property and the previous expenditure, but generally they want to receive half the shares in exchange for a control of the mine without putting up any capital themselves.

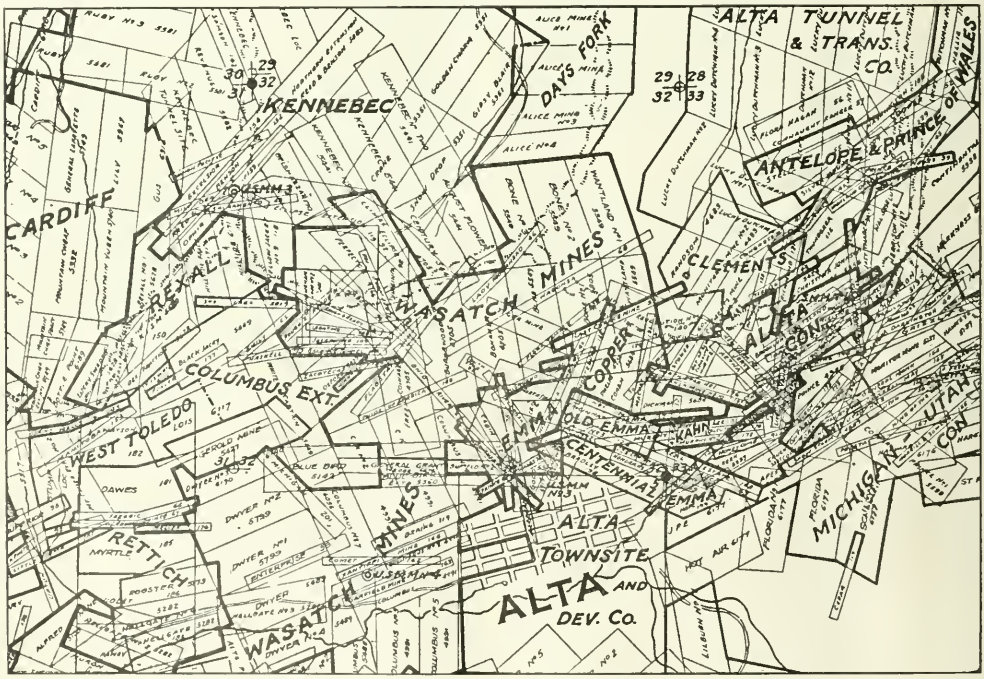
"This arrangement is not laid down in the Mining Regulations, but this is the way in which it is construed by the owners. Although a Chinese by birth I am a British subject, and therefore come under the heading of a 'foreigner' under these mining laws.

"Of course, another obstacle is the lack of company laws that would allow limited liability companies to be floated, as is so often done in the Straits under British law. If the Chinese understood from experience how to float companies and get capital subscribed they might be able to find their own capital, but there, alas! arises the question as to whether they could trust their capital in a purely Chinese company. The future of mining in China is undoubtedly great, but there is a long way to go before success is sufficient to invite capital."

Mining in Utah

By L. O. HOWARD

The fluctuations in the metal market come with such rapidity that forecasts in one month must be revised in the next. In my review of last month I referred to the effect of higher prices for lead in causing operators to speed-up production. Now this stimulus to maximum production has passed with the return of lead to normal and silver to so much below recent prices that the silver-lead producer is in a quandary. There has been no marked reduction in shipments from the silver-lead mines, and the search for zinc ore still goes on unabated. Two prominent phases of mining now attracting attention are the exploitation of old tailing-dumps and the continued speculation in stocks of the Alta-Cottonwood district.



MAP OF THE COTTONWOOD DISTRICT, UTAH. INCIDENTALLY, IT SHOWS THE EXTRAORDINARY CRISS-CROSSING OF CLAIMS DUE TO THE APEX LAW.

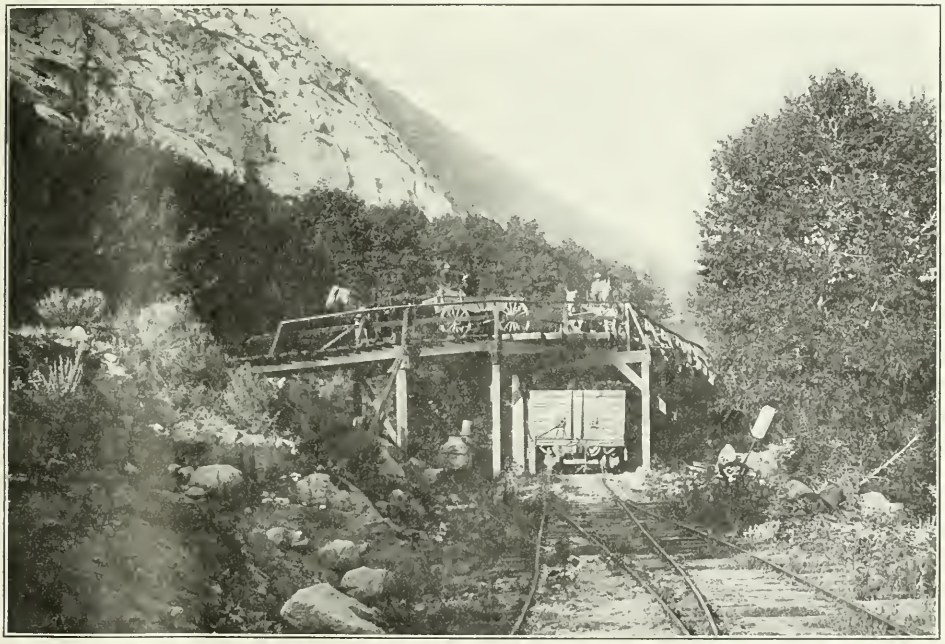
Aided by the high prices prevailing at the time the tailing projects were initiated, but owing their real stimulus to the increasing adaptation of flotation to diverse ores, three large mills are approaching completion. Mills ranging in capacity from a few tons to 500 tons per day are either at work or soon will be in reclaiming base-metal tailing. [One, on the Big Four at Atkinson, is the subject of an article to be published in our next issue.] Reference is made to operations of other mills, large and small, in the same district. One of the simplest of these small plants has only a jig and two tables. The tailing is shoveled from a platform to a jig with a fine screen, which rejects the coarse material and much of the worthless stuff, by combining the functions of a screen and a jig. The fine is drawn into the hutch and is then cleaned on two Wilfley tables, for the production of a zinc concentrate of excellent appearance. A little vertical steam-engine drives the plant; the whole of the equipment is exposed to the elements. I have also mentioned the use of flotation in the Broadwater mill, at Park City, for the recovery of the zinc.

In the southern part of the State at the Cactus mine, in Beaver county, further progress has been made in the use of flotation. The Broadwater mill depends on com-

bined concentration and flotation, whereas the Cactus plant will treat the tailing by flotation alone. There are several interesting features in connection with this plant, not the least being the content of the tailing, which is 0.8% copper. The mineral is principally chalcopyrite in a quartzite gangue, the reject from a wet-concentration mill using jigs, tables, and vanners. There is estimated to be 1,000,000 tons available for treatment. The mill has been designed to handle 500 tons per day. The tailing that passes a 6-mesh screen will be re-ground to 65-mesh in two Hardinge mills in closed circuit with two Dorr simplex classifiers. The 65-mesh product will be treated in a 12-cell Minerals Separation machine, for the production of a finished copper concentrate, a finished tailing, and a middling to be returned to the head of the machine with the feed. Tests indicate that the recovery will be close to 80%. It is expected that the plant will start operations early in October.

These tailing enterprises are being conducted by small groups of men who are using their own money. Vastly different are the majority of operations in the Alta-Cottonwood district. Much of the prominence of this district has been due to continuous boosting on the part of those interested in the stocks of companies owning ground there. The district, which is now divided into Big and Little Cottonwood, was one of the earliest to be opened in the West, and has an honorable record of production in the early days. At shallow depth water put an end to profitable operations in many properties, while in others the ore pinched. It is only recently that a serious effort has been made to prove ore in depth. There is a great deal of activity, for which some credit must, in all fairness, be given to those who have been behind the stock movement. While but three or four properties can be classified as mines, many of the others have prospective value, and will doubtless discover orebodies as work proceeds.

The country is a series of limestones, quartzites, and shales, dipping at 35° northeast, which is cut by two groups of fissures nearly at right angles. The northeast-southwest fissures give the best indications of ore. The formations are much broken by major and minor faulting of limited extent, so that exploration is rendered difficult. The geology of the district as a whole has never been satisfactorily deciphered. The ore is found in the fissures and at the contacts between different strata. No large orebodies, as compared to those found at Park City, for instance, are indicated as yet. Development expense is heavy and transportation facilities are not of the best. Silver, gold, copper, lead, and zinc, both oxidized and sulphide, have been found at varying depths in small amounts. Lead, silver, and copper predominate. The principal producer is the Cardiff, situated in the south fork of Big Cottonwood canyon. It is reported that shipments of oxidized silver-lead ore are now being made at the rate of 200 tons per day. The haul down the narrow-canyon roads, 28 miles to the sampling works in the Salt Lake valley, results in the



END OF WAGON-HAUL AT WASATCH, IN LITTLE COTTONWOOD CANYON. (Photo by Shiplers, Salt Lake City.)

employment of many men and teams and in greatly increased cost of operation, above what could be attained were an outlet to Little Cottonwood available. The ore is said to contain $35 in silver and lead. The present excellent appearance of this mine has been the excuse for boosting the district. At the beginning of the year stock sold at 6 cents per share, and went begging at that. Recently a nominal quotation of $5.10 per share was reached on the local exchange.

Only a few of the properties are equipped with power, but the Cardiff is to use power-drills as soon as a compressor can be had. The Maxfield, the most westerly property in the district, has pumping facilities and is endeavoring to unwater its workings, in order to gain depth below the canyon. Other properties at which work, mostly adits, is being done, are the Tar Baby, Carbonate, Price, Baker, American Con. Copper, Neva, Kennebec, Victor, Silver Moon, Cardiff Extension, Big Cottonwood Coalition, Alta Tunnel & Transportation.

On the Alta or Little Cottonwood side of the divide separating Big and Little Cottonwood creeks, the Michigan-Utah has a number of lessees at work, and is endeavoring to finance large operations. The South Hecla, Emma, and Michigan-Utah are among the important producers, and appear to have more ore than others on this side. Development work is being done by the West Toledo, Columbus Extension, Albion, Sells, Columbus Extension, and Wasateh mines. The Wasatch has a hydro-electric plant in the canyon and furnishes power for some of the others. Transportation is better on this side of the divide. The Michigan-Utah has an aerial tramway to Tanners Flat, 26,000 ft. long. From that point the ore is hauled three miles to Wasateh, the terminus of the railway. A 12-mile rail-haul brings the ore to the smelters in the valley. About 200 tons per day is now being shipped, my estimate being based on 100 tons for the South Hecla, 70 tons for the Michigan-Utah, and the rest miscellaneous shipments.

A large amount of money is being spent in exploratory work in this locality. This has been accompanied by wild speculation in the shares of some of the companies, the effect of which is not wholly beneficial. Most of the stocks are highly speculative, and a few cents per share would represent their intrinsic value. Some of them have been inflated to near the dollar mark, with no showing of ore to warrant it. There are bound to be many disappointments under such unfortunate conditions; these are likely to react to the detriment of the district. On August 24, two of the stocks fell from 80 and 87 cents to 30 and 44c., respectively, and are quoted but little higher at this writing. This happened with no change in conditions at the mines.

There is a report in the daily press that production of molybdenite was to begin from the Alta-Gladstone mine. Details are lacking.

The betterment in the copper situation is reflected in the report of the Utah Copper Co., for the second quarter. Comparing with the first quarter, the production of copper in concentrate was 40,799,825 pounds, against 26,415,995 lb. in the first quarter; ore treated was 2,215,159 tons, compared with 1,396,341; this is a new high record for the company. The grade of the ore treated fell off from 1.44% copper to 1.42%. Extraction was 64.85%. Cost of copper was reduced to 7.49c. from 8.19c. per pound.

During the high zinc market the mines of the Tintic district shipped 29% ore and received 5c. per pound at the railroad. This was not entirely satisfactory, but there was little choice. At the present time the differential is not so great, so that there is one source of happiness in the face of the declining market. At Saline activity is still pronounced. Twelve cars of zinc ore were shipped in August and further development by new interests is under way.

Among the lead mines the initial dividend of the Utah-Apex at Bingham is worthy of note. Much is expected from the operations of this company, which is now on a strong basis. Production is at the rate of 30,000,000 lb. per year at a cost of 3½c. per pound. Affairs of the Ohio Copper Co. are still involved, but the lessees are continuing production, and are treating 2000 tons per day.

At the lead smelters, production is maintained at the normal rate. The Garfield smelter is operating five coal-fired reverberatory furnaces and two blast-furnaces, treating about 2700 tons of copper ore daily, over half of which is concentrate from the Utah Copper Co. At the International smelter three reverberatory furnaces are at work on copper ore.

Rittinger's Law of Rock Crushing. In a paper to be presented at the September meeting of the American Institute of Mining Engineers, Arthur O. Gates states that his experiments confirm Rittinger's law, which is: "The work done in crushing is proportional to the surface exposed by the operation; or, better expressed for this purpose, the work done on a given mass of rock is proportional to the reciprocal of the diameter of the final product—assuming that all the mass has been reduced to one exact size, which is only theoretically possible." Rittinger's theory is the law of the *cracks*. It is well explained in an article by E. A. Hersam in the Mining and Scientific Press, an abstract of which is given in the third volume of Richards' 'Ore Dressing.' After the acceptance of the substantially correct theory of crushing, there must be recognition of the fact that rocks of varying characteristics are met in crushing operations, that these rocks offer different resistances to crushing, and that it is unfair to compare the operations of two crushing machines upon dissimilar ores (even if they look alike) until some values are given to the resistance or energy absorption of these rocks under crushing conditions. Probably these units will be determined practically by applying a definite amount of energy to a definite weight of the rock, all of a predetermined standard size. The work of determining these constants should be done thoroughly by competent hands. The conditions under which such constants should be determined are discussed in a paper by M. K. Rodgers.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Electrum is a silver-gold alloy that has been found in the National mine, Nevada. A slab of ore several inches thick and 3 by 6 ft. across yielded $70,000.

Calcite is the only gangue mineral found with the 'pocket' gold deposits of the Klamath mountains, California. The gold is later than the calcite and replaces it. It nowhere enters the calcite for any distance.

Hydraulics was defined by Olmstead in 1838 as "that branch of natural philosophy which treats of fluids in motion." It is a part of the science of hydrology, which investigates the properties and phenomena of water. Stream gauging is an important part of hydraulics.

Thermit-welding of cam-shafts at the Tonopah-Belmont mill cost $42.53 per shaft. There was 85 lb. of thermit used. The weld was turned down to the original size, and the shafts broke after 36 days' service. Another one was welded, but the boss of ½ in. high and 4 in. wide was left. This shaft is working well, the boss being in the middle bearing.

The increasing use of electric-blasting and of larger charges emphasizes the importance of watching the condition of all leading and connecting wires and blasting-machines to see that all are kept in good condition and that connections are well made. Avoid kinking wires, as this leads to cracks and breaks not easily detected through the insulation. Do not drag wires over the ground, as this scrapes off the insulation. Test the blasting-machine with a rheostat at regular intervals to see that it is working up to capacity. Test all circuits with the galvanometer before attempting to blast. These are simple time and money-saving precautions.

Human moraines are formed by the operations of dredges in the frozen North. The tailing heap blocks up and interrupts the course of the original stream, and produces a series of more or less stagnant pools in the loops it makes in its meanderings along the sides of the gully. If the latter is broad there may be two or three parallel embankments, with pools of muddy water between them, amid which the stream has to find its way as best it can. The mud that is washed out in the process lodges in these lagoons and buries the bases of the stony ridges. This curious effect of gold-dredging will last for centuries and it may puzzle some future geologist to account for its origin.

In setting up a new battery of five stamps at Skidoo, California, it was found advisable to use an old mortar, the ends of which had been cracked in a fire. The cracks were treated with 'Smooth-on' cement, and pieces of heavy strap-iron riveted over them. When the battery was started, the cracks were not tight, and water leaked under one of the post-shoes. The grouting was dissolved and pounded out, throwing the cam-shaft and stem-guides out of alignment. It was important to have the battery working again as soon as possible. To wait for new grouting to set would require too much time, so the cracks were gone over and made permanently tight. The battery-post with its shoe was raised to its proper height by means of chains and screw-jacks. The old grouting was then thoroughly scraped out and the shoe re-leveled with wedges. The space under the shoe was banked with wet sand and molten lead poured in. The result was excellent, only two days being lost. The work was done under the direction of L. W. Orynski.

Question and Answer. With two others I own three quartz claims on the Mother Lode in Mariposa county. Adjoining them is our mill-site. They were all located some years ago. During this summer we spent $700 or $800 on grading for the mill, putting in mortar-blocks, etc. This work was done not on the old mill-site, but outside of the side-line of one of the claims, on ground not located. Will you please tell me whether this work, under the circumstances stated, is assessment work, or will do as such, as little or no work has been done on the claims this year? And does the mining law permit us to have a second mill-site? The three claims are located consecutively from end-lines, and it is my understanding of the law, that a group of claims is entitled to one mill-site of five acres. We have such a mill-site, but it was inconvenient to use it. If the law does not permit us to make another location of mill-site so that we may take in the ground where we have made the improvements noted, in what way may we acquire legal possession of the ground? We do not wish to abandon the original mill-site.

If the claims were ours we would hesitate to allow their validity to rest on the performance of the work indicated, especially since it is outside of the boundaries of the claims. The Land Department has held that work on a mill does not benefit a quartz claim within the meaning of the mining statute requiring patent improvements. The courts have usually held that patent improvements are on the same basis as annual labor. However, the Courts are inclined to be more liberal with such improvements, and they would clearly allow grading for a mill to apply as an improvement on a claim if it were actually situated on the claim. Unless very strong reasons are presented, the Land Department does not favor the allowance of more than one mill-site, even when used in connection with a group of mining claims. On a good showing more than one mill-site claim has been allowed. Under the conditions presented, it would be advisable to make another location of a mill-site covering the ground on which the recent improvements have been placed and hold both mill-sites with the idea that if the Department would only grant patent to one that the least valuable one could then be abandoned.

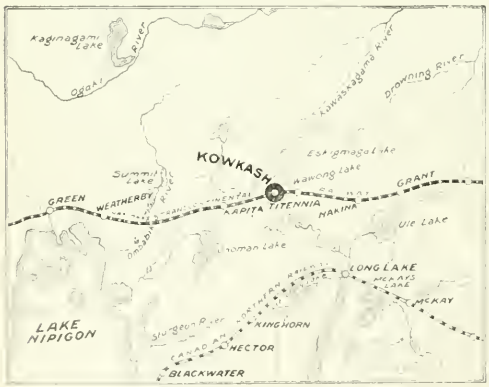
REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

TORONTO, ONTARIO

THE KOWKASH GOLDFIELD; HOW TO GET THERE AND PROSPECTS. —RICH ORE IN THE DOBIE MINE.—SUDBURY NICKEL DISTRICT.—POWER FOR PORCUPINE.—HOLLINGER MILL.—DOME MINE.—PORCUPINE PROSPECTS.

The greatest gold rush that has ever been witnessed in Northern Ontario has set in towards the new Kowkash field, about 300 miles west of Cochrane on the National Transcontinental railway. The first discovery was made by E. W. King Dodds on August 21, at a point on the Kowawkagashama river—mercifully abbreviated to Kowkash—some 20 miles north of Kowkash station from which point it is reached by canoe. Other prospectors quickly located claims, and many very rich specimens were brought to Cochrane, creating the greatest excitement in the mining centres of the north country. Many hundreds of prospectors from Cochrane, Haileybury, Porcupine, and Cobalt, have gone in, special trains



MAP SHOWING SITUATION OF KOWKASH, THE NEW GOLDFIELD.

being run to accommodate the gold-seekers, and the excitement has spread far and wide. As no staking had been done before the discovery last month, the chances for prospectors obtaining valuable claims are considerably better than in most gold rushes. Samples which have reached Toronto were stated by J. B. Tyrrell, one of the best authorities, as being exceptionally rich. They were taken from a vein of quartz and chloritic schist 6 in. wide. The country rock is diabase, which occurs freely for miles around. Basalt dikes occur as intrusives. The formation containing the shoots is paralleled by a broad belt of porphyry. Early prospectors had no difficulty in finding promising veins of quartz and schist on which to stake claims. One dike of quartz and chloritic schist 30 ft. wide, which is being stripped, is said to be similar to the best veins of the Hollinger, at Porcupine. Many men are now rushing in from distant points, including a number from the United States.

Some very rich ore has been found on the Dobie claims in Munro township, 50 miles east of Porcupine. These claims have been worked by the Dominion Reduction Co. for about two months, and until lately strict secrecy was maintained concerning results of development as the company was buying other claims in the neighborhood. A shaft has been sunk at an angle of 20° for 90 ft., and a large quantity of ore extracted, reported to assay 2000 oz. gold per ton. Two specimens of this ore, weighing together between 200 and 300 lb., are on view at the Canadian National Exhibition. It is reported that the company has a ton of ore of this grade sacked at the mine. The ore is found in bunches in a 2-ft. vein in diabase near its contact with basalt. This has been traced for several hundred feet, but the depth is not known. Officials of the Ontario Bureau of Mines, while not prepared to corroborate details as published, state that there is no question that an exceedingly rich discovery has been made. A large number of claims have been staked.

The discovery at the Dobie mine in Munro Township, has been quite eclipsed in public interest by the Kowkash stampede, but the first accounts of its importance appear to be fully borne out by later developments. The Dominion Reduction Co. has shipped gold valued at $50,000, extracted from 750 lb. of ore. It is estimated that the tailing contains $30,000 more. A shipment of $26,000 had been previously made from the same vein.

Nickel mining at Sudbury is very active. During August the Creighton mine produced over 73,000 tons. A new hoist is being installed at No. 2 shaft with a 5-ton skip, making the fifth hoist in operation at the mine. The other two mines of the Canadian Copper Co. also had large outputs. The Frood mine was closed down at the outbreak of the War, and about 40 houses moved to Creighton to accommodate the largely increased staff. An entire new set of fireproof shops are in course of construction, including electrical, carpenter, machine, and blacksmith-shop, and warehouses.——Some work is going on at the Vermilion mine, where the ore has been found to be difficult to treat, as in addition to nickel and copper, it contains platinum, palladium, and a little gold.

George T. Holloway, of London, the well-known metallurgist appointed chairman of the Ontario Nickel Commission, has arrived in Toronto, having spent some time before leaving England in gathering data dealing with the nickel market and its possibilities. He stated that a thorough examination of the Sudbury nickel industry would be made in order to prepare an estimate of the extent of the nickel deposits of Ontario, which would be followed by an inspection of the New Jersey refining plants.

The Northern Canada Power Co. has decided to extend its plant to supply Porcupine at a cost of about $1,000,000. Under normal conditions the present capacity of the plants at Waiwaiten and Sandy Falls is about 9500 hp., but when the water is low this is considerably lessened. The first extension will be at Sandy Falls, where a 2500-hp. unit will be installed. Afterwards the Waiwaiten plant will be increased. Dams will also be erected at various points in the watershed for the storage of water. The power requirements of the leading companies are likely to be greatly increased in the near future, as the Dome and Hollinger anticipate that within two or three years they will each need from 4000 to 5000 horse-power.

The Hollinger mill is now treating about 1500 tons of ore per day, and it is proposed to increase its capacity to 2000 tons. Ore from the crushing-plant will be screened, and the fine material sent direct to the tube-mills, the oversize only being crushed by stamps. Additional tube-mills may be required. The cyanide-plant is being extended, and eight settlers and two

agitators added to the continuous-decantation apparatus.—— At the Dome, horizontal drilling at the 700-ft. level has added to the ore reserves, the value of which is now estimated at over $17,000,000. The management has given extensive orders for machinery which will increase the milling capacity to 45,000 tons per month.

The satisfactory results of development by the larger Porcupine companies are causing a renewal of interest in prospects which have only been partly tested.——The Preston East Dome company will shortly start diamond-drilling on one of its claims adjacent to the Dome. Three of the directors have been inspecting the property to decide where drilling could be advantageously done.——The Temiskaming company, which has bought the minority interest in the North Dome, will also begin diamond-drilling this week.——Shareholders of the West Dome have ratified the proposal to re-organize the company. The new company capitalized at $3,000,000 will be known as the West Dome Consolidated, and shareholders will receive two shares of the new issue for each three of the old stock, leaving 1,000,000 to be sold to raise funds for development.

FAIRBANKS, ALASKA

Past, Present, and Future Aspects of Quartz Mining.—District Features.—Working Properties.—Mills.—Costs.

Quartz mining has been going on in a small way in Fairbanks district for over five years on small high-grade quartz veins containing free visible gold, and gold associated with sulphides. The predominant sulphides are stibnite, arsenopyrite, and pyrite, but galena and sphalerite are present in small quantities. Oxidized products from these sulphides are also present.

The conditions that prevailed have been almost prohibitive; but now that the Federal railroad between Seward and Fairbanks is under construction, and is expected to be completed within the next three years, the mining industry has taken new life, and new properties are being opened up.

The surface of the district is made up of ridges and valleys, but the relief is not great. The altitude of the ridges is about 2700 ft. above sea-level, and that of the flats about 700 feet.

Prospecting is rendered extremely difficult by reason of the bedrock, which is always schist, being covered by several feet of moss, 'muck,' and loose rock, most of which is permanently frozen. When 'float' quartz is once found, it can only be followed by sinking holes at intervals up the side of the mountain. When the vein is approximately located, it is necessary to dig trenches to bedrock and open the vein. After the 'pay-shoot' is found, the usual practice is to erect a windlass, and sink 50 or 100 ft. Then some ore is extracted and treated at a custom-mill.

Crites and Feldman, who own the only equipped and producing mine on Fairbanks creek, located their vein and shoot in this manner, and mined enough ore to pay for equipment. They have a 5-stamp mill and air-compressor with machine-drills, also a small saw-mill and all buildings to make the property complete.

The first ore mined yielded $130 per ton at a custom-mill. At present the adit-level is on 1000 ft. of a vein averaging about 6 in. wide. All stoping is being done above this level at present, and still farther up the hill two other veins have been exposed. One yielded 63 tons of $43 ore in doing 600 ft. of open-cut work on the vein, which was 6 in. wide. The other vein is 24 in. wide and returned $25 per ton. A shaft is now being sunk to prospect these veins at depth.

Nars, Anderson, and Gibbs, who own the extension of the Crites and Feldman vein, have a shaft down 100 ft., with 100 ft. of driving at the 600-ft. level, also some stoping on the vein, which was from 4 to 20 in. wide. This produced $27 per ton. The vein in both properties strikes northwest and dips southwest.

The McNeil and Huddleson mine has a shaft down 108 ft. on a vein striking north 60° west, and has 70 ft. of driving done on the 40-ft. level, and 70 ft. at 100 ft. Some stoping has been done on the vein, which is 8 to 40 in. wide. Ten tons of ore averaged $42 per ton at a mill. They have about 75 tons on the dump of approximately the same grade.

The Conners and Stevens mine, located near the head of Fairbanks creek, has the largest vein so far developed. It is from 7 to 10 ft. wide. From drifts at 60 ft. is produced 173 tons yielding $14.20 per ton. The vein strikes north and dips west, and is cut by several cross-veins striking east and west and dipping south. These veins vary in width from 6 to 18 in., milling from $25 to $60 per ton.

The Mispah claim, owned by A. Hess and associates, is just above the Conners and Stevens property. The vein strikes east and west and dips 75° south. The shaft is 120 ft. deep. On the 80-ft. level 100 ft. of driving has been done on a vein from 8 to 18 in. wide. About 40 tons of ore has been stoped that will assay about $40 per ton. One shipment of 14 tons from the surface on this shoot yielded $1160, or $83 per ton.

The Mispah vein crosses the Conners and Stevens property, and was located on the east end by L. M. Drury and others, who are sinking a shaft on a promising shoot 6 to 8 in. wide.

Foss and Farvain have a lease on the American Eagle claims No. 1 and 2, at the extreme head of Fairbanks creek. They have sunk a shaft 107 ft. on the ore-shoot, and driven a 500-ft. adit on the vein to cut it at greater depth. At present one stope is 80 ft. long varying in width from 32 to 44 in. From this 117 tons was extracted that averaged $14 per ton.

The mines in this immediate area have produced enough ore to justify the erection of a custom-mill. For some time a 5-ft. Huntington mill, at the head of Fairbanks creek, has been treating ore for $5 per ton; but when the large vein on the Conners and Stevens mine was found, Thomas Gilmore, who owns an interest in this property, decided to erect a 5-stamp mill to treat this ore, and also do some custom work. This mill will be completed in August. With two mills available for custom work it is expected that the Fairbanks Creek district will develop some mines of merit.

Owing to the fact that the veins are small as a rule, and usually badly faulted, they require close study and can only be worked at a profit by the owners themselves, or by good miners who are used to 'gophering,' and take them on a lease, usually paying 10% royalty.

Long adits to cut ore-shoots at depth are to be discouraged here, owing to the numerous faults and character of the formation. The erection of mills to treat ore developed by 100 ft. of driving or 50 ft. of a shaft should be stopped. This is emphasized by a score or more of idle plants in all parts of the district.

Among the other mines in the district that are being worked is the Homestake at the head of Wolf creek, a tributary of Clearly creek. It is worked under lease by O'Connors and Henderson, who have opened a rich shoot from 3 to 6 in. wide, striking east and dipping south about 45°. The ore is treated in the Rexall mill close by. These miners are making money where the company failed.

The Tanana quartz and hydraulic claims, controlled by Anthony Goessman, situated on Bedrock creek, a tributary of Cleary, have three veins opened. One is low-grade striking north and dipping west; the others are small and high-grade from 4 to 18 in. wide, striking east and dipping south, which have produced about 60 tons of ore averaging $75 per ton.

The Rhoads & Hall mine is on Bedrock creek, adjoining the Goessman. This mine has been working continually for the last five years under the personal supervision of L. B. Rhoads, the locator. The vein is from 8 to 18 in. wide, and yields about $40 per ton. To date the output is a little over $500,000. All the ore is stoped out above the 100-ft. level, and it will now be necessary to sink. As supplies are exceptionally high, wood

alone for steam power for 5-stamp mill and electric hoist and pump costing over $20,000 per year, the owners have decided to close-down and await the coming of the railroad, when the mine can again be worked at a good profit.

The Bradley mine, on Skoogy gulch, a tributary of Pedro creek, has a vein formation of altered schist and quartz about 90 ft. wide, which will assay between $3 and $5 per ton. With cheaper supplies, it may develop into a mine of large proportions. The same can be said of the Anderson and Birch mine on Granite gulch. Present conditions to not justify any development work.

As yet no depth has been reached in any of the mines, and none so far has shown large ore-shoots of good or even fair value, but there are many small veins and stringers of high grade that will pay good wages to the man who takes them out, and to him I can recommend the district.

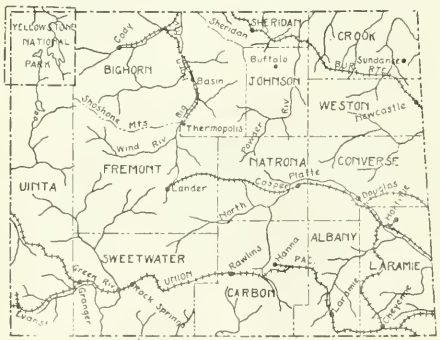
CHEYENNE, WYOMING

Sulphur. — Phosphate Plants. — Platinum. — Oilfields. — Potash.

The sulphur mines of Cody and Thermopolis are working full time. The crude material is used in making sulphuric acid, which is necessary in the manufacture of practically all the high explosives used in ammunition.

The phosphate plants along the Wyoming-Idaho boundary are again at work; their output practically all goes to Pacific Coast points.

The old Rambler mine at Holmes has again resumed operations. A concentrating plant has been installed, and high-grade platinum concentrate is being shipped. The new management has opened up a large body of ore, and it now seems certain that production will be continuous.



MAP OF WYOMING.

The pipe-line from the new Grass Creek oilfield has been completed to the C. B. & Q. railroad at Chatham. The oil is now being hauled to Casper for refining, but it is reported that the Midwest Oil Co. is to build a skimming plant at Chatham. The pipe-line was built by the Illinois Pipe Line Co., and the production of the field is controlled by the Midwest company, the Ohio Oil Co., the Fullerton Oil Co., and several local companies. There are in all about 30 producing wells. The six-inch pipe-line has proved to have a carrying capacity of 11,000 bbl. per day. This line is without pumps, having a drop of 1400 ft. in its length of 35 miles. Wildcat drilling has been almost at a standstill since the War began. Rigs are now being erected on favorable structures at two new points in the State, and it is confidently expected that these will result in new productive areas.

The high price of potash has intensified the interest in Wyoming potash prospects. It is hoped that a practical method of extracting potassium from leucite, (silicate of alumina and potash) has been evolved, and an experimental plant will be shortly built. A search for soluble potassium salts is being made among the numerous alkali lakes of the State. It is rumored that a potassium-sodium nitrate deposit has recently been discovered.

PLATTEVILLE, WISCONSIN

High Grade Takes Place of Low-Grade Product.—New Separating Plants.—Prices.—Lead.—Zinc Carbonate.

For genuine intensity of action, August stands out more prominently than any month so far recorded. A complete transition has been made from a low to a high-grade zinc-producing region. On account of the great and exacting demands for spelter, the large smelting concerns required high-grade concentrate only. Product containing under 58% zinc has practically no market at present. Dry methods of concentration, (roasting and electrostatic treatment of wet concentrate), enabled low-grade producers to make a product equal to requirements. Sufficient plants are now at work to treat the current heavy production, and to reduce the accumulations of about 10,000 tons at all points.

Of the many new separating-plants erected and building, one is deserving of special mention. This is being built next to the Champion mine at New Diggings, owned by the Wisconsin Zinc Co., a Maine corporation, and one of the subsidiaries of the American Lead & Zinc Smelting Co. The plant consists of one main building of steel and concrete, 100 by 140 ft., to house 10 Dings MM or medium, and H and HHH high-intensity machines. The complete mill will cost $60,000, and will be able to treat 150 tons of ore daily, and recover 500 to 600 tons of high-grade zinc concentrate per week. In the past year the Wisconsin Zinc Co. has developed zinc mines that will more than supply the ore required to operate the plant continuously. In additiou to this, the Company also took over the Joplin Separating Works at Galena, Illinois, owned by the Picher Lead Co. of St. Louis, after an idleness of three years. After repairs and overhauling this plant is in service.——The Fields Mining Co. of Shullsburg completed a plant at its mine.——The National Separating Works, producing one car of high-grade concentrate daily, enlarged its capacity. These plants however, are working on ores produced by tributary mines.

The building of custom plants, the one feature affording relief to small independent low-grade producers, was carried out to a satisfactory conclusion.——The Utt-Thorne Miuing Co. started a plant at Benton, placing a buyer in the field.——The Kistler-Stephens Co., of Platteville rehabilitated the Enterprise Zinc Separators, affording relief to nearly all low-grade producers in the Platteville district.——Some separating plants were started at a number of places, in many instances those that had been abandoned during the period of low prices, and which had existed for several years prior to August 1914. These too were consigned to the new work hoped for by low-grade operators, and the time is now almost at hand when very little product containing less than 58% zinc content will leave this field.

Prices for zinc concentrate during August were not so largely controlled by the metal quotations as is usual. Ore buyers were not active, bidding showing an utter absence of spirit, but still prices held up well. The decline in metal was met by one in ore that went as low as $55 per ton, basis of 60% metal, but long before spelter showed any signs of recovery, ore again began to climb and reached $86 per ton, showing real gains in favor of the miner. This price held strong at the close of the month, and the field was clear of high-grade material, the bins having been raked to supply the demand for finished product. The working off of the large reserve which had accumulated in the field is not such an easy matter as may appear, as the current production is rapidly increasing. A small car of

ore now brings from $2000 to $3000; a few years ago it realized less than half as much.

In the districts where the prospects of persistent ore deposits are better than others, every available foot of ground has been secured for its mineral rights. This was greatly accentuated by the passage of a new State law which removes the onerous taxation of orebodies yet to be proved. It is freely predicted by mining men that in another 60 days not a foot of ground will be available for leasing, unless transferred from parties first possessed.

Lead production in this field has depended for many years on the volume of wet concentration of zinc ores. Prices for pig lead experienced spells of depression during the month, receding to as low as 4.30c. at St. Louis, and regaining practically all lost ground, closing at 4.85c. The price of concentrate suffered, receding to $45 per ton from $60 paid in the early days of the month. Producers however, are not so much concerned now, since sphalerite is the ranking ore, and no sales were reported during the month. A reserve, variously estimated at from 2500 to 3000 tons of ore has accumulated, the Linden district holding about one-third of this amount alone.

Producers of crude iron pyrite contributed little raw ore during the month. Prices remained stationary, about $3.75 to $4 per ton, base of 50 units. The bulk of the sales reported came from separating plants where the recovery was made as by-product.

Producers of carbonate of zinc ore were again left entirely in the shade. The leading buying interest for the northern districts of this field, where this ore occurs, for years has been the New Jersey Zinc Co. Prior to 1914 the sales annually reached about 5000 tons, but so far this year a negligible quantity has been dressed for market, because this buying interest refused to pay the high prices demanded for an ore used exclusively in the manufacture of zinc oxide. Other buying interests that had the temerity on former occasions to invade this field were told by the New Jersey people to 'beat it,' and this they usually did. New buying interests crept in at the close of August, the Lanyon Zinc Co. securing several cars and paying fair prices. It appears certain now that the remaining months of the year will witness the development of sharp competition for this ore. Miners made large dumps of mill-feed through last winter's underground operations, which will now be quickly converted into a marketable commodity. Any outlet will be gladly welcomed by this class of miner, who has been practically starved out in the past year.

Deliveries of products in August were reported as follows:

Districts	Zinc pounds	Lead pounds	Pyrite pounds
Benton	10,542,000	.....	421,000
Cuba City	3,686,000	.....	1,746,960
Hazel Green	3,236,000	.....	.....
Livingston	2,210,000	.....	.....
Platteville	2,078,000	.....	.....
Mifflin	1,408,000	380,000	162,600
Linden	1,142,000	.....	.....
Shullsburg	544,000	.....	.....
Mineral Point	90,000	.....	.....
Highland	80,000	.....	.....
Potosi	52,000	.....	.....
Rewey	40,000	.....	.....
Total	25,108,000	380,000	2,330,560

The gross turn in of raw ore from all mines exceeded 24,000,000 lb. and net refined ores from separating plants and high-grade concentrates from mine to smelter direct, 15,000,000 pounds.

The most important work in the region was done in the south, where exploration, development, ore extraction, mill, power, and roasting-plant building showed great activity.

GOLDFIELD, NEVADA

Development in the Kewanas.—Inspection of District.—Jumbo Extension in August.—Sandstorm-Kendall.

The recent discovery of good ore in the Reorganized Kewanas property, at a depth of 840 ft., has aroused much interest, owing to the similarity of the ore and of conditions at the point of discovery to those in the Jumbo Extension mine, adjoining on the south. The shoot is in the shale-contact zone, and apparently in the main lode formation of the district, which has its apex on the Booth and Red Top. At this point the ground bears the same relation to the productive area in the Laguna and Red Top mines that the Jumbo Extension has to the Clermont. The stopes of the Clermont, on and above the 750-ft. level, have yielded the largest tonnage of high-grade ore of any in the district, and the Jumbo Extension has exposed a large tonnage of rich ore in the same lode, on its dip to the southeast and from the 850 to the 1000-ft. level. The lode, farther north, apexing on the Red Top, produced large quantities of rich ore to a depth of about 400 ft., where it passes, on its dip to the east, into the Laguna group of the Consolidated, and in the latter mine it has been worked and has produced good ore in large quantity, to a depth of over 750 ft. The object in exploring the Kewanas property and in sinking to the shale here was to find the point of contact between the lode and the shale, and this point has evidently been found. Copper is present in varying quantity, but a marked decrease in copper with increase in the gold-content has been noted as the drift progressed. A cross-cut is now being driven to the lode from a point in the main north drift, nearer the winze, from which all work is conducted.

F. L. Ransome, of the U. S. Geological Survey, has been in Goldfield for several days and has been making a comprehensive examination of mine workings in the district.

In the Jumbo Extension mine the contact ore-channel has been penetrated at a depth of 800 ft. This is the highest elevation in the mine where the contact ore has been found, and apparently marks the top of the hill or ridge of shale that rises above the fissure in which the best ore has been exposed. The secretary, Ben Gill, has released the following preliminary estimates of production and earnings of the company in August: ore mined, 3150 wet tons; gross value, $98,000; freight, treatment, and sampling, $28,000; mining, development, and administrative charges, $15,000; net realization, $55,000. This rate of production, yielding profits more than sufficient for a 10-c. quarterly dividend, will be maintained without difficulty, according to the management, and will be largely increased with the completion of the Velvet shaft.

Highly encouraging results are reported from the Atlanta exploratory work. At 1620 ft. the shoot so far is 150 ft. long, of $12 ore.

Work that is now being started at the Sandstorm-Kendall Consolidated property will attract attention during the next few weeks, as it involves cross-cutting and exploring the big lode at a depth of 700 ft. The winze from the east cross-cut on the 500-ft. level reached the 200-ft. point this week, having followed the steep dip of the lode, near the foot-wall. A station is being cut and a cross-cut will be driven to the hanging wall and then drifts will be put in. In the course of sinking many seams of good ore were exposed.

The Great Bend has completed all dead work and repairs to the old workings and has exposed the old faces on the 400-ft. level. The superintendent, Jack Campbell, will have the drifts extended on the main lode and a raise put up to prospect for ore found several years ago by lessees, in a winze below the 300-ft. level. The property is now in condition to make rapid progress with its development which has been planned by J. K. Turner, consulting engineer for the company. The surface plant is a duplicate of the equipment at the Velvet shaft of the Jumbo Extension. A new station pump will be installed shortly on the 400-ft. level.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

FAIRBANKS

Three and a half miles of placer ground on Greenstone Creek, near Ruby, has been purchased by the Yukon Gold Co. A 3.5-cu. ft. dredge will be constructed as soon as possible.

IDITAROD

(Special Correspondence.)—A Bucyrus drag-line excavator has been installed by F. G. Manley on his Willow Creek property. The machine has proved to be an efficient method for handling small dredging areas at a moderate cost for erection. This machine has a 1.5-cu. yd. bucket, 60-ft. boom, and 60-hp. boiler. The average daily capacity will exceed 1000 cu. yd. S. R. Fox is in charge of operations. He spent several years in California working a drag-line on a gravel mine, and expects to see this method successfully used in Alaska for excavating, where the floating dredge is not practical.

Willow Creek, July 29.

JUNEAU

July returns of the mines on Douglas island were as follows:

Results of operations.	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Stamps working ...	120	240 and 300	120 and 150
Days	21.72*	*19.77 and 28.11	29.67 and 29.15
Ore crushed, tons...	14,714	68,684	42,994
Gold by amalgamation	$12,025	$61,825	$48,625
Gold from concentrates	9,749	69,698	40,364
Total realizable value	21,557	130,207	88,100
Operating charges ..	17,256	85,782	53,373
Construction	3,241	30,942	8,687
Net profit	1,059	13,483	26,040

*The short run was due to the break-down of the Central hoist, as mentioned previously.

The stock of broken ore in stopes decreased in each mine.

At the Ready Bullion the building for 30 additional stamps is finished. Stamps will probably start work on October 1. Four Deister tables are to be tried instead of 12 vanners.

SEWARD

At the new townsite of Anchorage, the railroad terminus, the Federal government at the end of August sold 749 lots for a total of $167,000. A camping area of 300 lots has been arranged by the Alaska Engineering Commission.

ARIZONA

COCHISE COUNTY

On Labor Day, September 6, the Southwestern Mine Safety Association held its second meet at Warren park, Bisbee. A large crowd assembled to witness the contests. The results were as follows:

First-aid (1) Ray Consolidated, two teams tied with 93.4. (2) Detroit, 91.5. (3) Calumet & Arizona, smelter team No. 10, 90.1. (4) Copper Queen, team No. 6, 87.2. (5) Old Dominion, team No. 8, 86.9. (6) Arizona Copper, 84.4. (7) Calumet & Arizona, mine team No. 7, 81.6. (8) Calumet & Arizona, mine team, 81.4. (9) Copper Queen, team No. 9, 78.6. And (10) Old Dominion, team No. 1, 75.6.

Mine-rescue (1) Calumet & Arizona, team No. 2, 97.8. (2) Detroit, 94.4. (3) Copper Queen, 92.6. And (4) Old Dominion, 88.2.

In the evening the Warren District Commercial Club gave a dinner to the teams taking part. There were 150 present, including the Association Secretary, Wallace McKeehan, J. C. Roberts of the U. S. Bureau of Mines safety headquarters at Denver, and leading officials of the Copper Queen and other companies.

In Bulletin 104 of the A. I. M. E., ventilation of the Copper Queen mine is described by Charles A. Mitke of Bisbee. The mine consists of seven divisions operated by mine shafts from 600 to 1700 ft. deep, all being downcast save the Lowell, an upcast. On the even numbered levels the workings are connected by motor-haulage drifts. The Uncle Sam, Southwest, and Czar ground has many connections to the surface, and is cool and ventilated by natural means. The Holbrook division is ventilated partly by natural and partly artificial means, and the Spray, Gardner, Lowell, and Sacramento areas entirely by mechanical means. The system used is described in detail.

GILA COUNTY

The Miami Copper Co. reports as follows for the half-year ended June 30, 1915:

Development, feet	8,295
Ore treated, tons (2.1816% copper).....	589,513
Concentrate produced, tons (40.63% copper).....	22,708
Extraction, per cent (now nearly 80%).....	68.16
Copper output, net, pounds.....	18,453,543
Cost of producing metal, cents per pound (now lower)	8.6889
Gross income	$2,841,188
Profit	1,296,225
Dividend	373,556
Surplus	922,668

A number of important improvements were made to the mill, while others are under way.

On August 26 the Iron Cap company's report stated that during July, 18 cars of ore, containing about 47 tons each, and assaying up to 10.87% copper and 10 oz. silver per ton were shipped. The profit was $14,389. Development continues satisfactory.

From the 250-ft. level of the Warrior mine daily shipments to the El Paso smelter amount to 110 tons of 6% copper ore.

CALIFORNIA

BUTTE COUNTY

At the Success drift-gravel mine of G. W. Rumble a 50-ft. shaft has found that about 24 in. of a lava-ash and clay bedrock contains gold nuggets and averages $30 per cu. yd. The ash is very soft. Large lava boulders are embedded in it. Owing to the clay the material must be dried in the sun before washing in the usual way.

CALAVERAS COUNTY

A recent shipment from the Calaveras mine at Copperopolis averaged 10.02% copper, and netted $1090. The cross-cut on No. 4 level north shows improvement. On No. 6 level south the north face consists of 12 in. assaying 18.86%, and 60 in. averaging 3.37%. Experimental work continues at the mill.

ELDORADO COUNTY

A 10-stamp mill has been erected for J. Flynn at the Blue Rock mine near Georgetown.——The Georgia Slide mines have been surveyed by H. D. Jerrett of Placerville.

INYO COUNTY

On September 18 the lessee of the Cerro Gordo mine, Louis D. Gordon, will turn over the property to the company, his

lease having expired, but he will remain as manager. About 150 men are employed. The aerial tram to Keeler is carrying 100 tons of ore per day. The August output of zinc was 1620 tons. Up to September 18 the current month's yield is 1200 tons of zinc and 200 tons of lead.

Nevada County

(Special Correspondence.)—The full complement of 20 stamps is now dropping at the Union Hill mine. Production is $12,000 to $15,000 per month. The ore-shoot on the 770-ft., intermediary level has been opened for a distance of 170 ft., the east face is still in ore of mill grade. Two raises have been driven 200 ft. apart to a height of 135 ft., and a drift on the 700-ft. level has proved the ore for 200 ft. On this level the ore makes 50 ft. farther west than at 770 ft. and the east end still shows good ore. The company recently shipped 2.5 tons of tungsten ore to Denver, worth about $700. This ore occurs as scheelite in small bunches in the gold ore-shoots. This is the first shipment made.

Grass Valley, September 11.

The Union mine at Bear mountain, has been bonded to D. W. Shanks, J. Nelson Nevius, and other Los Angeles men, who have formed the Nevada County Gold Mining Co. The mine will be unwatered. It has been idle for several years.

The new 60-stamp mill at the Empire mine is crushing 8670 tons per month, almost double that of the old 40 stamp.

Plumas County

At the Walker copper mine, 22 miles from Portola, there are 150 men working underground and at mill construction. Machinery is arriving for the new plant.

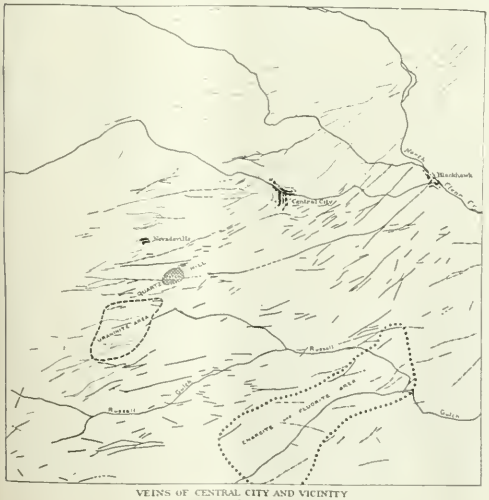
Shasta County

At the Noble electric smelter at Heroult one furnace is making ferro-manganese and another produces ferro-chrome. Ore for the latter comes from near Lowery in Tehama county.

COLORADO

Gilpin County

A detailed report on the economic geology of this county and adjacent portions of Clear Creek and Boulder counties, by



MINERAL DEPOSITS IN PART OF GILPIN COUNTY.

Edson S. Bastin and James M. Hill, is soon to be published by the U. S. Geological Survey. In *Economic Geology* for April-May, the former contributes an interesting paper on the ores of Gilpin county. It is presented with the idea of briefly giving the scientific results that are likely to be of most value to economic geologists. The region discussed is 30 to 35 miles west and northwest of Denver. It is the oldest lode-mining area in Colorado, being discovered in 1859. In Gilpin county the principal mining centres are Central City, Blackhawk, Nevadaville, Russell Gulch, Perigo, and Apex. The entire region lies within the area of pre-Cambrian rocks. Probably in early Tertiary times many igneous rocks intruded as dikes into the pre-Cambrian rocks, these intrusives being the 'porphyries' of the miners. Veins greatly exceed in number and importance all other structureal types of ore deposits of the region. Most of the orebodies occupy zones of minor faulting, and are true veins. These commonly strike between east-west and north 45° east, and dip at angles of 60° or steeper. Flat veins are rare. The width is often between 1 and 5 ft. The largest vein noted is the Mammoth near Central City, where it is traceable on the surface almost continuously for 6000 ft. The greatest depth to which a vein has been followed is 2250 ft. (on the dip), in the case of the California.

The ores of Gilpin county and adjacent areas described may be grouped according to the metals which give them their predominant value, into the following five classes: (1) Gold-silver ores, which constitute the main economic resource of the region; (2) uranium ores, highly localized but of much interest as a source of radium; (3) tungsten ores, which form the basis of the tungsten industry of Boulder county, the largest producing centre for this metal in the United States; (4) copper ores, poor in precious metals, represented solely by the Evergreen mine near Apex; and (5) titaniferous iron ores of Caribou, Boulder county, which are not commercially valuable.

The region forms part of a broad mineralized belt embracing most of the important centres of Colorado.

Lake County (Leadville)

The Yak Mining, Milling, & Tunnel Co. recently secured an extension of its lease on the Aladdin property, near the head of Big Evans gulch, for 10 years, also a bond for $600,000 to become due within that period. According to the manager, W. W. Davis, the tunnel will be extended into the area. The Diamond winze, 200 ft. below the face of the tunnel, has opened ore. The Vega winze is to be sunk 150 ft. deeper. From the portal in California gulch to the Diamond winze the tunnel has a length of about four miles. The face is 900 ft. below the surface. Its extension will bring it near the Mosquito range, in territory that has been little developed. The Yak company and lessees are regularly producing gold, silver, lead, and zinc-bearing ores.

A motor on one of the pumps at the Penrose shaft burned out last week, but it was quickly repaired.

About 500 tons of 15% carbonate of zinc is stored at the Western Zinc Oxide Co.'s plant. The daily capacity is 50 tons. The Company is paying off its debt to the original company.

San Juan County

Ore shipments from the Silverton district in August totaled 171 cars, equal to 3591 tons.——The Sunnyside mine continues to dispatch high-grade zinc ore.

IDAHO

Ada County

(Special Correspondence.)—The Ironsides mine, eight miles from Boise, is to be re-opened by the Black Hornet Mining Co., headed by Mrs. Hortense Adams. A wide lode has been worked out to 240 ft. depth. The ore averages $8 per ton. Deeper work is to be done. The property is well equipped with mine plant and a 20-stamp mill.

Boise, September 2.

Elmore County

(Special Correspondence.)—The Boise King Placers Co. has resumed work after a long dispute between shareholders. The

property is well equipped for hydraulicking. There are 1250 shareholders, more than any other company in Idaho. George J. Albert is superintendent.

Boise, September 2.

OWYHEE COUNTY

(Special Correspondence.)—The American Nitrate Co. of Chicago has erected a small testing-plant on Succor creek. The average content of the deposit is 4% potassium nitrate.

Boise, September 2.

SHOSHONE COUNTY (COEUR D'ALENE)

The Success company's earnings were $152,256 in August, of which $120,000 was profit. Six or eight cents per share will be distributed this month.——In a raise from the Keating adit the Caledonia vein was cut 40 ft. sooner than expected. It shows good ore.——The Hypothek is employing 26 men, and has commenced shipping ore from the 900-ft. level.——The Polaris claims near Osburn have been leased to W. E. Mann of Waverly, Washington. He will be in the market for machinery at an early date.

There is said to be a shortage of skilled machine-men in the Coeur d'Alene region. The wages are $3.50 per shift of eight hours.

MICHIGAN

THE COPPER COUNTRY

According to the *Boston Financial News*: August outputs are as follows,

Mine	Ore Tons	Mineral* Pounds
Tamarack	23,600	448,400
Osceola	136,815	1,915,000
Ahmeek	74,250	1,930,000
Wolverine	34,000	698,000
Mohawk	69,000	1,316,000
Franklin	13,000	261,000
Centennial	5,800	96,000
Allouez	48,825	862,000
Mass	30,000	540,000
Superior	19,400	388,800
Hancock	8,500	153,900
La Salle	13,300	240,500
South Lake	1,125	27,000
New Arcadian	.....	28,760
Isle Royale	63,000	853,500
Calumet & Hecla	290,000	7,940,000
Copper Range	104,000	5,004,000
Victoria	16,500	250,000
Quincy	.....	2,111,000
Winona	12,000	240,000
White Pine	20,800	686,400
Houghton	.....	40,000
Lake	5,400	93,500

*66⅔ metal.

Repairs to the turbo-generator at the Calumet & Hecla were completed on August 30, and all re-grinding plants of the company are working.

MISSOURI

JASPER COUNTY

Production of the Missouri-Kansas-Oklahoma region during the week ended September 5 was as follows: blende, 6048; calamine, 592; and lead, 835 tons, averaging $75.48, $58.04, and $49.81 per ton respectively. The total value was $531,517; and to date $15,780,527. The output is nearly 22,000 tons of concentrate per month, an increase of 4500 tons over this time last year. The Webb City-Carterville district contributes 8500 tons, and Joplin, 3000 tons. On September 1 wages of underground men were reduced 50c. per day, due to the reduced prices received for ore. Many operators made little profit in August.

Plants being erected or re-modeled in the region will increase the capacity by 3000 tons per shift. They include one 1000, one 500, one 400, two 300, two 250, two 200, and one 150-ton plant, and several sludge plants.

MONTANA

ELKHORN COUNTY

At the Boston and Montana company's property the main adit is in over 2000 ft. The west drift toward the Idanha vein is in 150 ft. in granite, and the east drift toward the Park vein is in 110 ft. in soft, highly mineralized ground. At 100 ft. east a 10-ft. vein was cut, containing considerable mineral and was broken up.

LEWIS AND CLARK COUNTY

(Special Correspondence.)—Mining development is on the increase in the Helena mining region, according to the Helena Mining Bureau. The King Solomon mine in the Clancy district, 15 miles south of Helena, has been taken over by the Monarch Mining & Milling Co. with ample capital. The mine is now being unwatered, and a large amount of ore is blocked out on the 400-ft. level for stoping. The ore at 600 ft. will be cut with 125 ft. of drift and cross-cut. The machinery has a capacity for 1200 ft. and is of the latest type. The King Solomon group is one of the oldest producers of the district that was tied up by financial difficulties and a bad accident in the workings a year or so ago. Ike Moreland, one of the principal stockholders, succeeded in making a re-organization, and the mine will be shipping regularly by the middle of September. About 40 men will be employed for a start.

Profit at the Franklin mine, owned by the Cruse estate, in the Scratch Gravel district, was $8000 in August. The Cullen Miller property adjoining the Franklin is blocking out ore. A discovery of 18 in. of high-grade gold ore was made on the 200-ft. level on August 30.

Helena, August 30.

If the city of Helena withdraws its suit over the water of Ten-mile creek against James Breen of the Porphyry Dyke mine in the Rimini district, he will erect a 500-stamp mill. A 20-stamp mill has been treating $2.25 to $3 ore, at a cost of 60c. per ton for mining and milling. The deposit is said to be of enormous dimensions.

SILVERBOW COUNTY

On Labor Day, September 6, Butte had a big day. It included first-aid contests, which were won by the Original team with 89.6%, followed by the Leonard with 89.2%. The work was well done.

The Butte & London shaft has been unwatered, a 1200-gal. per minute pump has been installed at 1100 ft., and sinking is under way from this point to 1600 feet.

NEVADA

According to F. M. Manson, general manager of the Utah Ore Sampling Co., who recently returned to Salt Lake City after an extensive tour of Nevada, there is more mining activity in Nevada at present than for years. Operators take a decidedly optimistic view of the metal market, and are expecting higher prices for silver. New districts are being opened, and new developments are reported in nearly all of the districts throughout the State. The recent discovery of gold in several new districts has given an impetus to the industry that heretofore was apparently in need of no stimulus. Mining men attribute the greater activity to the decided increase in prospecting that has been going on for some time past.

ESMERALDA COUNTY

A northeast drift recently started on the 800-ft. intermediate level of the Jumbo Extension has cut 5 ft. of $133 ore. The mine is shipping 80 tons of ore averaging $45 per ton.

At the Florence, the superintendent, Harry B. Clapp, is to commence exploring both walls of the Reily stope, which

produced about $2,000,000 in the early days of Goldfield. Developments at 250 ft. depth are very satisfactory.

HUMBOLDT COUNTY

Transport of ore in the Rochester district was greatly facilitated on September 8 when the Nevada Short Line carried its first trainload from the foot of Rochester hill to the mill, nearly three miles away. The extension of the line was recently completed up Rochester canyon to the foot of the tramway, which is also the portal of the Friedman adit; henceforth ores will go by rail instead of by teams. New rolling stock is being procured and the line will be able to handle all tonnage produced up to 500 tons per day, a quantity which cannot be mined until after the stopes are opened from the deep-level adit. This is in 775 ft., and should be complete to 1200 ft. in about 40 days. All of this work is being done by the Rochester Mines Co., which accounts for most of the operations in the district.

Owing to a breakdown, the Seven Troughs Coalition company's August gold output was only $48,000, against $70,000 expected for the full month. A new 100-hp. gas engine is working well. Just prior to the trouble the bullion yield per 16 hours was $2500. This was from a 20-in. vein at 1200 ft., south drift, assaying $2100 per ton. The average from all parts of the mine in August was $100 per ton.

MINERAL COUNTY

(Special Correspondence.)—The Golden Pen Mining Co. recently shipped 205 tons of ore that averaged $118 per ton; another lot of 19.5 tons assayed $1012 per ton. This shipment included 962 lb. worth $3.63 per pound; and 100 lb. valued at $18.84 per pound. Only two men have worked at this mine, but in less than a year they have shipped over $50,000 of high-grade ore. Only one carload shipment was made previous to that of last week, but it averaged $600 per ton. The owners report three stopes opened on the first level, showing the same class of ore as already extracted, from which regular shipments will be made.

From the Mims lease on the Queen Regent Merger mine a car of ore was dispatched last week having a gross value of $1150, this being the second car from this lease during the past 30 days. This ore occurs on the foot-wall; the mill ore being 5 to 7 ft. wide, and has increased from $12 per ton on the 80-ft. level, to $20 to $30 on the 100-ft. level. The main working shaft of the Queen Regent has reached a depth of 150 ft., and is being sunk at the rate of about 14 ft. per week.

The Last Hope mine, adjoining the Queen Regent on the west, is sending out another carload to the railroad for shipment to the Hazen sampler. The shipping ore of this mine is uniformly good, the last carload averaged above $90 per ton. Up to date the Last Hope mine has produced over $30,000 of ore developed to a depth of 250 feet.

From the C. M. Hempel mine a recent shipment was made that assayed $16 gold, $1.60 silver, and $20 lead per ton.

Rand, August 31.

NYE COUNTY

Owing to the holidays the Tonopah mines produced only 9037 tons of ore worth $188,626 during the week ended September 11. Lessees contributed 294 tons of this quantity.——The Extension mill is treating 260 tons daily, and a thickener is being installed.——A number of working faces in the Belmont mine are in better than average grade ore. Last week's silver shipments totaled 193,671 oz.——Developments in the Jim Butler continue to be good.

Some activity at Manhattan is as follows, according to the local Chamber of Mines on September 1: Preliminary negotiations are under way towards a combination of the three properties on Litigation hill, namely, the Manhattan Amalgamated, Earl, and Litigation Hill Merger companies, the new company to also include the Manhattan Milling & Ore Co.'s 10-stamp mill, sampler, and cyanide-plant. This arrangement appears to be attractive, as ore is developed in each of the three properties, especially between the lines of the Amalgamated and the Earl claims, where there is a fine body of developed ore from the 300-ft. level, the owner of the ore being undecided, but immediately available should a merger be consummated. Each company also owns an adequate mine plant, including pumps, hoist, cars, tools, track, buildings, etc., with a large ore-bin situated on the Earl property, and also as part of the Earl machinery, an air-compressor, with machine-drills, etc. With the company to control its own milling plant, it would mean that it could start mine and mill operations at a profit immediately, with practically no dead work necessary.

It is stated that the White Caps Mining Co. has made a good payment to creditors.——At the Big Pine mine some rich ore has been cut at 200 ft. The daily output is 150 tons. A new concentrator of Homer Snyder is being installed to save some gold that fails to be amalgamated.——Lessees are resuming at the Union Mine claim of the Dexter company.——The War Eagle mill has been treating material from the Big Pine waste dump of 75,000 tons, to see if it was profitable.——A new gravel deposit has been found in one of the gulches near Timber hill.

At the Train Chase lease on the Mustang a rich deposit was cut last week. It consists of a series of veins containing soft, decomposed quartz and talc, averaging $200 per ton. The material is in limestone, near the shale contact, 15 ft. below the surface.

NEW MEXICO

DONA ANA COUNTY

(Special Correspondence.)—It is reported that the Bennett-Stephenson, Torpedo, Memphis, and other properties in the Organ district are to be sold to W. Rowland Cox for $975,000. They were once profitably worked on a large scale. Some ore has been shipped from this district for some time.

Las Cruces, September 5.

OREGON

MALHEUR COUNTY

In Bulletin 620-B of the U. S. Geological Survey, the nitrate deposits in southern Idaho and eastern Oregon are described by G. R. Mansfield. The deposits, 26 miles by road southwest of Homedale, Owyhee county, were discovered in the spring of 1914 by D. J. Sullivan. The nitrate occurs in veinlets which have not been developed far into the rock mass. The richest part of the deposit is probably that already exposed, and as the rock is opened the veinlets may disappear.

TEXAS

EL PASO COUNTY

Exports of gold and silver bullion from Mexico through El Paso during the fiscal year ended June 30, 1915, were as follows:

Year.	Gold.	Silver.
1915	$ 1,372,750	$3,291,621
1914	245,244	1,270,786
1913	No report	No report
1912	625,725	2,334,607
1911	10,907,271	1,605,265

UTAH

JUAB COUNTY

The Tintic Smelting Co. is to be dissolved. It was incorporated in November 1906; the plant (cost $1,000,000) operated for about a year in 1908-1909. The property failed to pay because the Knight mines did not produce all the ores required to make a suitable flux, and other smelters in Utah contracted for all the available ores of the character needed, which made it impossible for the smelting company to operate. Part of the smelter will be used in constructing the new mill at Tintic.

SALT LAKE COUNTY

A 1000-ft. adit is being driven into the Steele claims in

American Fork canyon. Some ore is expected in a short distance. Three diorite dikes and a large porphyry dike will be cut farther in.

The Alta Tunnel & Transportation adit is in 1500 ft. The rock now consists of limestone stained with manganese. The flow of water is increasing all the time.——In the Cottonwood King company's adit at 975 ft. some rich copper ore has been cut. L. T. Wakeham is superintendent.——A carload of ore from the Emma mine to the Garfield smelter returned gold, $1.50 per ton; silver, 16.6 oz.; lead, 18.2%; and iron, 29%. The faulted area in the mine is being thoroughly prospected. The property is well equipped for expiditious work.——The Alta Consolidated is shipping two cars of ore to the smelter.

SUMMIT COUNTY

Ore shipments from Park City during August were as follows: Big Four, 216; E. J. Beggs, 110; Daly, 29; Daly-Judge, 2330; Daly West, 829; Silver King Coalition, 2941; Silver King Consolidated, 1491; and Utah Sampling Co., 26, a total of 8319 tons.

In October, the Silver King Coalition company will distribute 15c. per share, a total of $187,500. To date dividends amount to $13,584,885. Good progress is being made in installing the flotation apparatus in the mill.

WASHINGTON

STEVENS COUNTY

On Silver creek, 18 miles east of Northport, two prospectors named Johnson and Yoder are reported to have discovered a large outcrop of high-grade lead ore. The property is named the Electric Point. The nearest railroad is at Boundary, 12 miles away. According to Sidney Norman, a depth of 20 ft. has been reached, and 100 tons of clean galena and an equal quantity of carbonate ore has been extracted. There is little silver in the ores.

KOREA

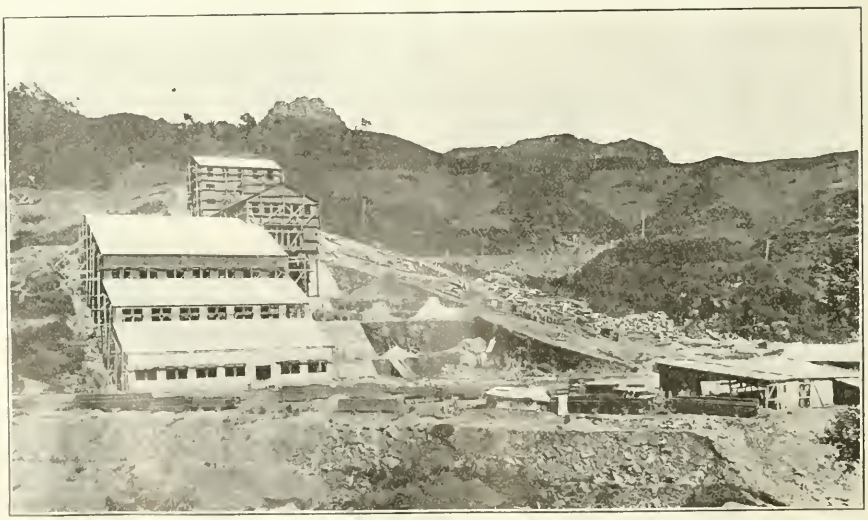
The Seoul Mining Co., operating the Suan concession in Whang Hai province, reports the following results for August, at the Suan mill:

Ore treated, tons	6,368
Mill operated, days	25.5
Bullion	$42,500
Concentrate	24,800
Total value	$67,300
Operating expenses	$27,500
Net earnings	$39,800

The August output of the Oriental Consolidated mines totaled $127,800. In July the rainfall was 42 in., the subsequent floods reducing the output to $97,536 from 23,099 tons. The various plants yielded the following:

Tabowie	$24,584
Taracol	15,265
Maibong	16,398
Candlestick	2,101
Taracol cyanide-plant	34,941
Maibong tube-mill	3,696
Candlestick cyanide-plant	550
Total	$97,535

Between July 10 and July 30, inclusive, there was 41.75 in. of rain. This tremendous fall interfered with all operations, and caused much damage to the property. Many landslides and washouts took place in the Tabowie-Taracol valley. The acting-foreman at the Taracol mine, John Arthur, was killed by a landslide which destroyed his house at 0.30 A.M. on July 17, and 60 Koreans were killed by the flood the same night. All of the bridges were washed away, also a large part of the Taracol double track, between the mine and mill. The water pipe-lines to the Taracol mill were broken, and those to Tabowie mill were filled with sand. Both of the electric-power systems were stopped, as parts of the high-tension lines were washed away, and owing to the stoppage of power the mines began to fill with water. The company's hydro-electric plant was started after a shut-down of 26 hours, and Okura & Co.'s plant started after a stoppage of 38 hours. In



THE NEW TUL MI CHUNG MILL BEING ERECTED BY THE SEOUL MINING CO. ON THE SUAN CONCESSION. THE PLANT WILL TREAT 400 TONS OF ORE PER DAY. THIS PHOTOGRAPH SHOWS PROGRESS OF CONSTRUCTION ON AUGUST 1. OPERATION WILL COMMENCE ABOUT SEPTEMBER 20. WITH THE SUAN MILL THE TWO PLANTS WILL HAVE A CAPACITY OF 600 TONS PER DAY. FLOTATION IS TO BE USED AS A SUPPLEMENTARY PROCESS IN BOTH MILLS. ORES ON THE CONCESSION CONTAIN GOLD, COPPER, AND BISMUTH.

the meantime, pumping was done with steam, water from the mines was hoisted, and the water was kept from reaching No. 6 level of the Taracol mine, and No. 12 level at the Tabowie mine. At Maibong the rain was not quite so severe as in the northern part of the concession, and the Charabowie mine was not flooded on any level, as the water was allowed to accumulate behind the cement bulkhead on the south side of the shaft. There has been no rain since July 30. The damage is being gradually repaired. All of the mills are working at full capacity, but as the skips in shafts have to be used for bailing water a part of the time, ore sent to the mills comes from lower-grade stopes in the older upper parts of the mines, and from dumps on the surface. The Unsan and Chosan districts' cordwood railways suffered from the rains, which washed out fills and embankments and covered the tracks with large slides of debris. All of this has been cleared away, the lines have been repaired, and the trains are running. Some 7000 mining timbers were carried out of the Taracol yard by the flood; 4000 have been recovered. The extraction obtained in the Taracol cyanide plant during July was 76.2%. This is below the average, and the poor result is probably due to the irregular run, caused by the rains, which stopped the power supply and the delivery of concentrates. The extraction obtained in the Maibong tube-mill in July was 108.6%. This abnormally high recovery is due to having changed over from grinding in water to grinding in cyanide solution, and the results obtained during July make up for the June deficit. The Chorrie reservoir is full.

CANADA

British Columbia

The Hudson Bay zinc mine on Deer creek, in the Sheep Creek district, is being bonded by R. K. Neill of Spokane. From 30 to 40 men will be employed, and large shipments made.

On September 30 the Hedley Gold Mining Co. will pay a quarterly dividend of 3%, and an extra of 2%.

The Standard Silver-Lead company at Silverton has made arrangements, to sell its zinc concentrate, with a United States company. At present there is on hand 2500 tons assaying 43% zinc and 30 oz. silver per ton. The daily output is 20 tons of this product. Only lead concentrate has been sold lately, at the rate of 1300 tons per month to the Trail smelter. September earnings are expected to be abnormally high on account of the zinc.

Last week the Trail smelter received a total of over 10,000 tons of ores and concentrates, the first time this year to exceed that quantity.

The Slocan district is in a thriving condition.

Ontario

The McKinley-Darragh Savage company will pay a dividend of 3% on October 1, equal to $67,431. The total to date is $4,607,000, or 205%.——A 100-ton mill is to be erected at the Teck-Hughes, also a power-plant. Buffalo people are interested.—— The Porcupine Crown mill is treating 50 tons of tailing daily, in addition to 100 tons of ore from the mine. Development at 600 ft. is encouraging.——The new vein has been cut at 100 ft. in the Keeley at South Lorrain. It is of good width and grade.——A high-grade narrow vein has been cut at 200 ft. in the Currie mine.

MEXICO

Hidalgo

The Santa Gertrudis company reports as follows for the second quarter of 1915: ore treated, 41,557 tons; bullion extracted, $249,000; net profit after paying working expenses and London office, $76,000. Development amounted to 4782 ft. in the upper parts of the mine. Of this, only 835 ft. was in average low-grade, though profitable, ore. The mill worked at 40% capacity until late in June, when it was increased to 60%. On July 13 it was closed on account of shortage of lime. A period of very irregular operation appears probable.

PERSONAL

Robert E. Kinzie is at Salt Lake City.

Jay A. Carpenter is here from Tonopah.

J. A. Daniel has gone from London to Bolivia.

E. K. Craig is returning to Skidoo, California.

Richard Baird is here from Greenhorn, Oregon.

John W. Finch was at Salt Lake City this week.

H. W. Hardinge has been at Cobalt and Porcupine.

Fred. B. Ely of Salt Lake City, is in this city, on his return from Alaska.

Wallace E. Pratt, Chief of Division of Mines, Philippine Islands, is at Berkeley.

Donald F. Irvin has returned to Pasadena from Central America and the Canal Zone.

Frank H. Sistermans and D. M. Munro, recently in Mexico, are attending the Engineering Congress.

John S. Colleran, auditor of the Seoul Mining Co., will return to Korea by the *Chiyo Maru* on October 2.

D. C. Jackling passed through Phoenix, Arizona, on September 7, on the way to the Ray mine and Hayden smelter.

George T. Holloway has left London for Ontario to work with the Nickel Commission, of which he has been appointed chairman.

R. A. F. Penrose was here with the intention of attending the Engineering Congress, but had to return to Denver last Wednesday.

H. H. Webb was seriously injured in a motor-car accident last Sunday in San Francisco, but he is doing well, we are glad to add.

J. B. Tyrrell was prevented, at the last moment, from coming to San Francisco, being called to inspect the new discoveries at Kowkash, Ontario.

B. F. Wade, hydraulic engineer, has joined the staff of the Redwood Manufacturers Company with headquarters in the Hobart Building, San Francisco. Mr. Wade will confine his attention to the design and construction of wood-stave pipelines for power, irrigation, and water-supply purposes.

Schools and Societies

The Montana State School of Mines re-opened on August 31 with 20 new students. Others are expected. The junior class is surveying the Moonlight mine at Butte. The senior class is soon to visit the East Helena smelter. The faculty at the School which is a branch of the State university, consists of C. H. Bowman, president, and G. W. Craven, Theodore Simons, Bancroft Gore, D. C. Bard, A. E. Adami, and L. J. Hartzell, professors.

The Southern California section of the A. I. M. E. states that in order to make its meetings more interesting and fruitful, the executive committee has formed a sub-committee on programs for section meetings. It announces for the coming autumn and winter season, four dinner meetings, at intervals of two months, in which the co-operation of all section members is urgently requested. The subjects chosen for discussion at these meetings, with the proposed dates, are as follows: September 28 'Mining Geology of Mojave County, Arizona;' December 14, 'General Geology and Mining Conditions in Southern California;' February 1, 1916, 'Petroleum, Its Geology and Technology;' and April 4, 'General Mining Conditions in South America.' Notice of the hour and place of each meeting will be issued later.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, September 16.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	4.75—5.70
Quicksilver (per flask)	$90
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	28

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, September 16.—Copper is firm owing to advances in London; on account of overstock, lead is dull; spelter is weak and dull.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Sept.	9	Aug. 4	18.27
"	10	" 11	17.94
"	11	" 18	16.89
"	12 Sunday	" 25	16.27
"	13	Sept. 1	17.83
"	14	" 8	17.62
"	15	" 15	17.42

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended September 8 totaled 8,123,441 lb., worth $1,542,133. France secured 3,799,811; England, 2,903,349; and Sweden, 1,120,350 lb. Imports amounted to 4,184,091 lb., valued at $592,739. Of this, 2,932,602 lb. came from Peru, and 832,580 lb. from Japan.

Dividends declared are as follows: Chino, 75c.; Magma, 50c.; Nevada, 37.5c.; Phelps-Dodge, $2.50 and $3; Ray, 37.5c.; and Utah, $1 per share.

In August the East Butte produced 1,785,000 lb., and Greene Cananea, 2,902,000 pounds.

On account of a dispute over wages several thousand men at the Clifton, Morenci, and Metcalf districts of Arizona went out on strike early this week.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept.	9	Aug. 4	47.08
"	10	" 11	47.27
"	11	" 18	47.33
"	12 Sunday	" 25	47.08
"	13	Sept. 1	46.77
"	14	" 8	48.20
"	15	" 15	48.56

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47 52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49 03	Dec.	49.27	....

The above quotations indicate an uncertain market, and it is difficult to state what is the disturbing factor. On September 14 the Director of the Mint purchased 250,000 oz. at 48.75c., and 250,000 oz. at 49c., for the Philadelphia Mint.

Exports from London to India and China to August 25 total £4,506,500, against £3,201,250 in that period of 1914, a decrease of, say, 13,500,000 oz. Imports of merchandise by England from China in the first half of 1915 show an increase of 63%, while exports to China fell off 52%. This remarkable falling off necessitates a substitution of so much silver, or credit in some form based on silver, in order to balance the altered conditions of trade, according to Samuel Montagu & Co. It is possible that the balance of trade between China and other countries, especially the United States, may not have altered in the same proportions, but it is reasonable to assume that the movement of trade was somewhat similar. If this assumption be correct, it is hardly probable that China is in a position to re-sell permanently any portion of the large stock held in London on account of that country, though, possibly, there may be occasional attempts to make a favorable sale with a view to replacement at a profit.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest produeer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug.	18	90.00	
"	25	95.00	
Sept.	1	95.00	
"	8	95.00	
"	15	90.00	

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Sept.	9	Aug. 4	5.12
"	10	" 11	4.79
"	11	" 18	4.44
"	12 Sunday	" 25	4.49
"	13	Sept. 1	4.87
"	14	" 8	4.90
"	15	" 15	4.63

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

The St. Joseph Lead Co. of Missouri is paying a dividend of 1½%, against 0.5%.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Sept.	9	Aug. 4	17.79
"	10	" 11	15.12
"	11	" 18	12.21
"	12 Sunday	" 25	11.96
"	13	Sept. 1	15.75
"	14	" 8	14.77
"	15	" 15	13.92

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The U. S. Geological Survey has issued Press Bulletin 234, covering the spelter situation during the first half of 1915.

The Missouri-Kansas-Oklahoma output in the week ended September 11 was as follows: blende, 5655; calamine, 502; and lead, 803 tons, averaging $72.10, $65.78, and $48.05 per ton respectively. The total value was $479,289.

On September 30 the Butte & Superior will distribute 75c. and $5 per share, making $9.75 for the current year. The August output was 13,878,981 lb. zinc from 45,140 tons of ore. The main shaft at 1750 ft. is in 27.6% ore.

The Canadian government is to buy all of the zinc produced by the new plant at Trail, British Columbia.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On September 16 tin was quiet at 33 to 33.50 cents.

Eastern Metal Market

New York, September 10.

The entire market is generally dull and weak, aluminum being the only exception. The recent advance of electrolytic copper to 18c. did not carry with it the confidence of consumers, and substantial concessions since then have failed to rouse them to activity. It is notable that sellers of small lots are doing as little as the larger sellers, and the entire trade is puzzled. Zinc has continued to decline in a dull market. Fear of labor trouble in the ore district is causing uneasiness. Contrary to all expectations lead has been reduced $4 per ton by the A. S. & R. Co. Large consumers of tin for export, in the form of finished products, are disturbed by more stringent regulations which Great Britain has ordered. The new restrictions will add to the difficulties which the tin-plate mills experience in their export business. Food containers are specially mentioned. The antimony market is a waiting one. Aluminum is now nominally quoted at 40 to 45 cents.

Semi-finished steel and pig-iron continue to advance. The steel industry is making new records. The Steel Corporation in August produced more ingots than in any other month, as did the independent companies as a whole. The pig-iron output in August was 2,779,647 tons, or 89,666 tons per day, against 82,691 tons in July. The capacity of the 249 furnaces in blast on September 1 was 91,075 tons per day, which was only exceeded in February and April 1913. Steel billets have sold at $26 and $27, Pittsburg. The demand for steel to be manufactured into shells continues enormous, and over 3c. per lb. has been paid for rounds. Thousands of tons are seeking placement. In the machinery end, a feature is the large number of manufacturers who have engaged in the building of machine-tools, especially lathes. So far, there has been a ready sale for them.

COPPER

The market has been dull to the point of stagnancy, and jobbers as well as the producers and dealers in wholesale quantities of copper are complaining of the lack of business. All are asking themselves, and others, what the trouble is. The retailers say they never saw anything like the present lack of demand, while the large dealers are wondering what has become of the War consumption. The best explanation is that these are strange times. Unusual symptoms are encountered by those who try to diagnose business conditions, and the prophets are all awry. No one can read even a few days ahead, to say nothing of trying to forecast what a few weeks or months will bring. The exports of unmanufactured copper are exceedingly small, totaling but 3442 tons in the first 10 days of September. Of course, a great deal of metal is going abroad in the form of munitions, but the exports, coupled with purely domestic consumption, do not seem sufficient to offset the large production which, admittedly, is running ahead of deliveries. It is to be regretted that authentic figures such as were formerly issued monthly by the Copper Producers' Association are not available. For a time, after the price of electrolytic advanced to 18c., New York, about August 26, the producers endeavored to maintain that figure, but repeated efforts to stimulate consumers by lower offerings have been made. As usual, second-hands led in offering concessions, but these were of little avail. The fact is that the rise was too rapid and simply augmented the conservatism of buyers. It is reported that producers have invited bids at 17.25c., while second-hands are ready sellers at that figure. In the absence of buying, prices are entirely nominal. Lake has been dormant since sales were made at 18c. Foreign exchange per pound sterling was quoted on September 10 at $4.69¼. Its advance from the low point of $4.50 had a salutary effect on the market, but was not sufficient to start buying.

ZINC

Quotations continued to decline until yesterday, 14c., New York, and 13.75c., St. Louis, was asked for prompt delivery. The market, except for flurries of inquiry, has been dull. On September 7 the inquiry was sufficiently definite to establish prompt at 14.50c., New York, September at 14c., and last quarter at 13.50c. Brass-mill special could have been bought at a premium of about 2c. over these prices. 'Bertha' is no longer quoted, but 'Horsehead' is still around 40c. As with copper, the general idea that production far exceeds consumption is a depressing influence. Something of which little is being said, but which, nevertheless, is causing worry, is a growing unrest on the part of labor in the Western mining regions. Should trouble come in this direction prices will surely advance. Manufacturers of brass and copper products have not yet resumed the quoting of base prices, more because of the unsettled condition of the spelter market, than because of the price of copper. Painted barb wire is being exported in large quantity in place of the galvanized product. It is quite as satisfactory for use in the construction of the entanglements used in military operations. Exports of spelter since the beginning of the War, according to C. Mayer, secretary of the New York Metal Exchange, total 9946 tons from foreign, and 114,405 tons from domestic ores. Exports from September 1 to 10 amounted to 653 tons.

LEAD

In the face of predictions that the quotation for lead was likely to remain at 4.90c., New York, for at least a few weeks, the A. S. & R. Co., on August 9, reduced its price 20 points—$4 per ton—to 4.70c., New York. It is true that independents had been selling at 4.82½c., New York, but the quantity dealt in was not thought to be large enough to have any great effect. After the announcement, the outside sellers reduced their quotation to 4.65c., New York. Previous to the decline, the St. Louis quotation was 4.75c., although it was intimated that 4.72c. would be accepted. Exports of lead since the beginning of the War total 32,442 tons in bond, and 76,346 tons domestic. Since September 1 exports amount to 848 tons.

TIN

The trade is seriously disturbed by amendments to the guarantees which England exacts from the importers and purchasers of tin. In a special notice, under date of September 9, the Tin Committee of the New York Metal Exchange set forth the changes.

As for the market, it has been extremely dull. Prices stiffened a little with the betterment in foreign exchange, but buyers have not taken hold. The quotation for spot, New York, was 33.25c., September 7, and 33.12½c. on the 9th and 10th. Arrivals up to September 10 totaled 1495 tons, and there was afloat on that day 5163 tons.

ANTIMONY

Waiting for buyers has been about all sellers have had to do in the past few weeks. There is plenty of Chinese antimony which can be had at 28 to 29c., duty paid.

ALUMINUM

Many complaints are heard of the inability to secure spot aluminum in the form of sheets and rods, and manufacturers are looking about for substitutes, where the lightness of aluminum is not absolutely essential. In pressed form it is being used in the manufacture of shrapnel fuse-timers, and this with the continued heavy demand from automobile makers has made spot and nearby metal scarce. Meanwhile the nominal prices have mounted to 40 to 45 cents.

BOOK REVIEWS

The Sampling and Chemical Analysis of Iron and Steel. By O. Bauer and E. Deiss, translated from the German by William T. Hall and Robert S. Williams. P. XIV, 373. Ill., index. McGraw-Hill Book Company, Inc., New York, 1915. For sale by the Mining and Scientific Press. Price, $3.

A third of this book shows by numerous examples, illustrations, and diagrams, how difficult it is to obtain a correct sample of iron and steel and also discusses the erroneous results obtained when the influence of segregation is neglected. It was the thorough treatment of segregation in the German edition that led two members of the chemical staff of the Massachusetts Institute of Technology to translate the book. To the accurate German methods of analysis the translators have added 25 less laborious procedures fitter for American laboratories and an accurate method for the determination of combined oxygen.

Standard Handbook for Electrical Engineers. Prepared by a staff specialist, Frank F. Fowle, editor-in-chief. Fourth edition. P. xvi, 1984. Ill., index. McGraw-Hill Book Co., Inc., New York, 1915. For sale by Mining and Scientific Press. Price, $5.

This is a handbook for specialists. In its preparation the publishers have divided the entire field of electrical engineering into 25 sections, each complete in itself; the index references are to section and paragraphs; a thumb-index facilitates reference. In this edition (about 400 pages longer than the previous one) a new section, No. 25, has been added on General Engineering and Central Station Economics. The bibliography annexed to each section is most valuable. Section No. 19 on electro-chemistry is full of valuable information for the metallurgist. Unusual uses of the electric-furnace are the production of the volatile substances bisulphide of carbon, zinc, and phosphorus. The statement is made that when coke costs $7 per ton, and electric energy $10 per annum, the cost of production of iron in an electric-furnace is approximately the same as in a blast-furnace.

Annual Report of the Smithsonian Institution for 1914. P. 729. Ill., index. Washington, D. C. Government Printing Office, 1915. Can be procured through the Mining and Scientific Press.

An extraordinary collection of information, ranging from articles on the constitution of the atom to modern theories regarding the sun. There is something to suit the most bizarre taste. Sad reflections arise on reading the account of a successful flight of Langley's aeroplane. By an unfortunate accident to the launching gear in December 1903 Langley missed the honor rightly due to him as the first successful aviator. Still more depressing thoughts come on seeing the perverse ingenuity applied to the manufacture of explosives. The picture of the 16-in. shell, weighing 2400 lb., with its powder charge of 666½ lb., is terrifying, but the plate showing the 3-in. high explosive shell with the thousands of payments resulting from its explosion shows more clearly diabolical nature of war. Of special mining interest is an article on the Klondike and Yukon goldfields wherein is shown the geological changes made by dredging and hydraulicking. The geology of the bottom of the sea and climates of geological time, together with the form and constitution of the earth, gives new ideas concerning our planet. Future generations are thought of in the article on play school for children carried on in connection with the summer school of the University of California; this is perhaps the most useful article in the book. The anthropologist will find astonishing types of humanity in an article on early inhabitants of western Asia.

Commercial Paragraphs

An electric-furnace for melting 24 tons of steel per 24 hours has been ordered by the Canadian Brakeshoe Co., Quebec, from the Snyder Electric Furnace Co. of Chicago.

Norman B. Livermore & Co., of Los Angeles, announces that C. A. Baechtold, of the Lidgerwood Manufacturing Co., has joined the firm. His headquarters will be mainly at 1106 Hibernian building, Los Angeles, but he will also cover San Francisco territory at intervals.

The International High Speed Steel Co., with works at Rockaway, New Jersey, has published a neat little pocket-volume of 56 pages. Full details are given about the company's types of steel produced, and its treatment, including mining and solid and hollow rock-drill steel. A lot of useful data is spread throughout the book.

The Hardinge Conical Mill Co., New York, has received an order from the Nevada Consolidated Copper Co. for two 8-ft. diameter Hardinge mills to be used with iron balls: also an order from the Dome Mines Co., Ltd., of South Porcupine, Ontario, for two 8-ft. diameter ball-mills. These ball-mills are to take the place of stamps now in use at the Dome mill.

The following awards have been given the United States Steel Corporation and subsidiary companies by the Panama-Pacific Exposition: The Corporation, two grand prizes, special gold medal, and three medals of honor; National Tube Co., grand prize for the general excellence of its tubular products and fittings, greatest merit being recognized in the well known specialties; medal of honor for each of the following: Oliver Iron Mining Co., Pittsburgh Steamship Co., Pittsburgh and Conneaut Dock Co., H. C. Frick Coke Co., Duluth, Missabe and Northern Railway Co., Carnegie Steel Co., and Illinois Steel Co.; gold medals for each of the following: Bessemer and Lake Erie Railroad Co., Birmingham Southern Railroad Co., Duluth & Iron Range Railroad Co., Elgin, Joliet and Eastern Railway Co., Newburgh and South Shore Railway Co., Union Railroad Co.; and grand prizes each for the Carnegie Steel Co., Illinois Steel Co., Tennessee Coal, Iron and Railroad Co., Lorain Steel Co., American Bridge Co., American Sheet and Tin Plate Co., American Steel and Wire Co., and the Universal Portland Cement Co. Gold and silver medals were awarded the various collaborators of the entire exhibit which covers one-fifth of the area of the Palace of Mines and Metallurgy.

The Western Electric Co., New York, sends us the following: The pneumatic hammer, which has held first place in coal mining, will meet keen competition from a new electric hammer that has just appeared on the market. The hammer, known as the 'Number 8,' has been brought out by the company, and is similar in appearance aud construction to the 'Number 7' recently put on the market by the company. The new hammer is heavier and more powerful than any of its predecessors, which will make it available for heavy duty mining work. It is recommended for taking up bottom, sweeping the roof in gangways and headings, and doing other rock excavation incident to coal mining. The greatest recommendation that this electric hammer has is its economy, and it is claimed that it will run at a power saving of 85% over air. It is more flexible; needing only a pair of wires, while the air-hammer needs a compressor with its attendant piping and incidentals. Flexibility, simplicity, and economy should make the electric hammer popular in the mine.——The Portland, Oregon, branch of this company has moved to a well equipped new brick and concrete building at East Ash and Union streets.

Additional train-despatching facilities are to be installed by the Illinois Central and Atlanta & West Point railroads. The former's plans call for 10 complete stations, making 60 in all, and the latter's plans require 13, making a total of 43. The Western Electric Co. will supply the apparatus.

EDITORIAL

T. A. RICKARD - Editor

UNDER Mining News we give a telegram received, when we were going to press, from a trusted correspondent at El Paso, summarizing the position in Mexico as it affects the mining industry.

IN the first year of the War the total gross tonnage of shipping captured, detained, sunk, or damaged amounted to nearly 4,000,000 tons, distributed among 3000 vessels. Of these, 418 vessels were neutral, 521 German, 476 British, and 75 Austrian.

AMONG the ceremonies incidental to the International Engineering Congress was to have been the presentation of the John Fritz medal, awarded this year to Mr. James Douglas. The ceremony was postponed on account of the absence, through illness, of the recipient. The Fritz memorial medal will gain in lustre by association with the name of James Douglas.

CYANIDATION of sand and slime from the mills along the Mother Lode in Amador county is not a success, save in one or two instances. Graphitic slate or schist is the trouble. Amalgamation and concentration yielded an average of 85%, from 629,000 tons of $4.89 ore, in 1914. The slime assays over $1 per ton, and is worth treating. Recent experiments seem to suggest a way out of the difficulty: amalgamation followed by flotation will recover the concentrate and remove the graphite, while permitting cyanidation of sand and slime, thus adding considerably to the gold output of the region.

PERSONS are said sometimes to be conspicuous by their absence; a process may be said to be renowned by the omission to mention it at a meeting of the American Institute of Mining Engineers and likewise at an Engineering Congress. "The bubble reputation" of flotation will not lose thereby, even if the technology suffers. It is curious that silence on the subject was so completely preserved during the proceedings of the last two weeks in San Francisco. However, this paper has endeavored to restore, and will continue its efforts to restore, the balance between silence and publicity on a metallurgical process of such insistent importance.

AFTER a period of apparent inactivity the Western Federation of Miners has started a strike at the copper mining and smelting centres of Clifton, Morenci, and Metcalf, all in Arizona. Several thousand men, including a large number of Mexicans, are employed there. Wages are paid on a sliding-scale based on the price of copper, and the pay is good; but evidently the men, led by labor agitators, are not satisfied with their lot, and so have 'downed tools,' compelling a shut-down of the mines and reduction works. This district produces about 6,000,000 pounds of copper per month, the properties being operated by the Arizona Copper, Detroit, and Shannon mining companies. The effort of the Western Federation to dominate the labor-unions in Arizona will, we hope, meet with a failure similar to that which befell the Moyerites in Michigan and Montana. For the solidarity of labor we have respect and sympathy; for the propaganda of an anarchistic coterie only anathema.

FOR countless generations nations have striven to accumulate gold; the nation with the most gold per capita was considered the financial leader. Now a novel situation has arisen and with it a new doctrine. The United States is accumulating gold too fast, but instead of rejoicing, our leading bankers are preaching that unless great wisdom is displayed, this influx of gold may lead to financial demoralization. The bankers argue that there is a normal status of equilibrium between the various countries of the world as regards gold holdings. This normal status is now upset by the influx of gold from Europe. This excess of gold is likely to lead to unwise extension of credit, unwarranted starting of new enterprises, and over-speculation. With the cessation of the War the gold will be withdrawn, with the possible result of a disastrous financial disturbance. All this is what might happen, but forewarned is forearmed. The leading bankers of the country are trying to arrange for the payment of the debt due from Europe in interest-bearing securities or dividend-paying shares in profitable properties either in the United States or abroad.

DURING this week of conventions, speeches, and papers, one feature emerges clearly, namely, the recognition of public service. Amid all the distractions of the moment the most memorable episodes have been the tributes to General G. W. Goethals and to the late Joseph A. Holmes, to the quick and the dead. The engineer of the Panama Canal was the first speaker at the International Engineering Congress. He spoke modestly of his own achievement and did not fail to acknowledge the usefulness of the work done by his two predecessors. Those who heard him were impressed with his sense of public duty and the force of character that enabled him to stay with his task until it was finished. At the special meeting of the Mining Congress that was set aside as a memorial to Holmes, the brief tributes of respect offered by a number of representative men all dwelt upon his devotion to duty, his sincerity of purpose, and the con-

sistency of character that enabled him to make an enduring contribution to human welfare. In both cases the word 'loyalty' was in frequent use, the loyalty to public service that elicits the devotion of associates and assistants in any great enterprise. It is no less remarkable that the appointment of Mr. Van. H. Manning as the second Director of the Bureau of Mines has evoked general approval primarily because it is known that he showed unswerving loyalty to his chief. The public shows a right instinct in assuming that such loyalty to such a chief is a guarantee of faithful service for the Nation.

The Institute Meeting

The San Francisco meeting of 1915 will, we believe, go down in the chronicles of the American Institute of Mining Engineers as one of the most successful. The two days of business and the additional two or three days of pleasure were full of incident, from the informal reception at the Bellevue hotel on the Wednesday evening to the garden-party in Berkeley on the Sunday afternoon. While the opening ceremony was not graced by any State or City official, the speech of welcome consisting of sundry well-worn fragments of oratorical confectionery delivered by a henchman of Governor Johnson, yet the occasion was redeemed by a vigorous speech from the President of the Institute, Mr. W. L. Saunders, who was able to give the Governor's delegate a not inconsiderable amount of valuable information on the part played by mining in the industrial community, more particularly of California. Mr. Saunders dealt with the same theme on the following day, when he received one of the medals presented by the Exposition authorities to the engineering societies. We take pleasure in giving the full text of his eloquent address on another page. The reading and discussion of papers may be said to have constituted a minor feature of the meeting, not many of the authors being present. On such occasions most of us prefer to chat with old friends in the lobby instead of listening to the labored summaries of papers that we can read at our leisure. The best discussions, we are told, were those on covellite at Butte and on copper leaching, provoked by the papers respectively of Mr. A. Perry Thompson and Dr. L. D. Ricketts. A delightful rumor points to the latter as the next President. The banquet at the Palace hotel was graced by the ladies and proved a most agreeable function. Mr. Van. H. Manning received a warm welcome on his first appearance since his promotion to the directorship of the Bureau of Mines. The speeches were not remarkable, but Mr. Edward Benjamin proved a most acceptable toastmaster. On Saturday 200 members and their womenfolk enjoyed an excursion on Mr. D. C. Jackling's yacht, viewing the Exposition from the water and visiting the Selby smelter. On Sunday a large number accepted the invitation of Mr. and Mrs. Charles Butters to a garden-party, which, thanks to a perfect hospitality and a lovely afternoon, proved most delightful. Fortunately every day of the meeting was fair, California proving true to tradition. This enhanced the architectural beauties of the Exposition, which, of course, absorbed all the spare time of our visitors. Most of us will have been stimulated by the renewal of old acquaintances and the warming of ancient friendships. That, after all, is the best feature of such conventions. Indeed, the gathering was notable for the large number of distinguished veterans that were present. This speaks well for the renewed interest taken in the activities of the Institute by the most influential portion of the membership. However, several notable members were conspicuously absent: Mr. W. R. Ingalls, the editor of the *Engineering and Mining Journal,* had been expected; so had Mr. J. Parke Channing and Mr. Philip N. Moore. We are sorry that Professor Kemp was unable to preside at the geological session, his absence being doubly regrettable because due to illness. We speak for many in wishing him a speedy recovery from the effects of over-work. In concluding this brief account we deem it only proper to associate the success of the arrangements with the name of the chairman of the executive committee, Mr. Charles W. Merrill. To him and to his wife, as chairman of the Ladies Reception Committee, is due a grateful acknowledgment, which we venture to make, not officially, but out of knowledge of the facts.

Fool Luck

The Greenhorn mine, the Green Emigrant, and the Lucky Boy are actual names of Californian mines. These, and many similar names, record the good fortune that often comes to the unskilled. The Green Emigrant recalls a hot day in the 'fifties when a tired miner, who was ground-sluicing in the bottom of a gulch, was accosted by a pair of lately-arrived Germans, who could hardly talk English. "Vere shal ve vork?" they asked. The miner was weary. Scanty returns had embittered him; the shade of a tree, far up the hillside appealed to him: "Up there, under that tree," he said. After supper he laughed with his chums at the stupidity of the greenhorns hard at work on a side-hill, far above any possible chance of finding gold, which, as all the experienced diggers knew, was found only in the streambeds. The Germans worked stolidly, uncomplainingly, egged on by the miners, who thought that a few days hard work would teach the newcomers a useful lesson and, in the meantime, keep them out of the crowded ravine. The emigrants, instead of becoming disgusted, seemed quite happy in their work, much to the surprise of the miners below, who were astonished to learn that rich gravel had been struck in the shaft sunk on the barren hillside. The green emigrants had found one of the fossil rivers, or deep leads, that have since yielded their golden sand so bountifully.

A similar story is that of the Swede, Charles Anderson, who struck it rich in the Klondike. He was a pick-and-shovel miner at Forty Mile. One day in 1897 he invested some of his earnings in a series of drinks that

left him at the mercy of two marauding prospectors, who sold him No. 29 Eldorado, which they thought worthless, for $600, his total savings. Next day the Swede found himself with a headache, less $600, plus a claim somewhere up the river. He was frantic. But to no avail. The two perpetrators winked the other eye and left camp for Quartz creek while Anderson decided that he must go and test his claim. He did; he went 80 miles to Eldorado creek and sunk 18 feet on No. 29 where on bedrock he found a fortune. A few days later the two wise men from Quartz creek, on their way to Dawson, passed the Swede at work and asked him, in jest, how he was faring. He answered: "Ay tank Ay got some gold here" and showed them a pan with $1400 in it. The claim yielded $1,250,000.

History repeats itself. This time in Alsace, ignorance has proved profitable. An ancient spinster was persuaded by a geologist to bore for coal in her small forest-estate. The geologist was at fault; no coal was found. When a depth of 1000 feet was reached the lady's funds gave out; relatives and friends of the obstinate old lady came to her relief; they formed a new company, called the Bonne Esperance. With the new capital, the boring was continued, yet no coal was found. But at a depth of 1900 ft. a strange deposit was cut, a mineral by turns white, gray, or a fine brick-red, in shining crystals; it was a salt of potassium in large amount: a fabulous fortune. In all 300,000,000 tons—so it is said— of potash salts has been developed, the estimated worth being $13,000,000,000. The district containing the deposits is being attacked by the French; if they succeed in holding these mines their yield will aid greatly in repaying the losses of the War. So it is said.

The Mexican Fiasco

The A. B. C. and the B. U. G. conference of August 11 was followed by an ultimatum to the factions in Mexico. That ran its course until September 13, when the same mediators, with Secretary Lansing, re-assembled in order, apparently, to inform one another of the absolute failure of their pronunciamento. On October 9 they are to meet again, presumably to make another declaration of policy that will prove just as futile. In August the Mexican leaders were given reasonable time to get together and establish a stable government. They were invited to send delegates to a conference. Villa, Zapata, and others who were getting the worst of the desultory civil warfare agreed to do so; Carranza refused, claiming that he and his supporters constituted a *de facto* government. Last week the mediators decided to recognize the Mexican faction best fitted, "materially and morally, to protect the lives of foreigners and nationals." Nobody is mentioned as coming within this description, but General Carranza undoubtedly will jump to the conclusion that the description is a veritable portrait of him and of nobody else. Meanwhile we are assured that "there is no disposition on the part of the Administration to interfere actively in the affairs of Mexico." That seems fairly evident. Moreover, we are informed that "the manner of arriving at the Mexican party which shall finally receive the endorsement of the United States and Pan-American governments was left to individual representatives." So that no unity of action is presumed. As the government to be recognized "must possess the material and moral capacity necessary to protect the lives and property of nationals and foreigners," it is clear that the aforesaid recognition is postponed to the Greek calends. Mr. Carranza may have some "material" advantage over Messrs. Villa and Zapata, but any editor is bound to delete the word "moral" out of the text. Truly it is a sad mess. The immediate effect of the New York conference has been to compel a recall of the consuls—both American and European—and their nationals out of northern Mexico, because the apparent intention to recognize Carranza constitutes a declaration against Villa and his rule in the states of Chihuahua and Sonora. It will also antagonize the Zapatistas in Morelos, Guerrero, and Michoacan. Those who are familiar with the real state of affairs in Mexico are of the opinion that Carranza is utterly incapable of forming a stable government. If he is recognized and supported, we may expect one of his generals, say, Obregon, to start a revolt at an early date, breaking away as Villa did. A rumor that the Pan-American conferees may choose Alvaro Obregon as a provisional president is more hopeful. That would mean the recognition of the Constitutionalist party, but not of their First Chief, as he calls himself, Venustiano Carranza, who is an obstinate and pompous person without the faculty of inspiring loyalty in his associates. The choice of Obregon would placate Villa and Zapata and minimize the chances of a new revolution. If Obregon is chosen and strongly supported, order may be restored. We cannot see how any conference of diplomats is to bring order out of chaos. Force can be countered by force alone. To talk morality to the factions in Mexico is likely to be as effective as the singing of a hymn to a burglar. Famine may be the force that will presage peace. These 'generals' fighting for the sacred cause of Liberty have been exporting grain in order to buy munitions, they have been devastating the country for two years with considerable success, they have terrorized productive industry with unquestionable thoroughness, they may have to stop their raids when hunger has camped on their trail, they may come to an agreement when it pays them to desist from fighting—not till then. Our information is that the whole border, from Nogales to Brownsville, is simmering with intrigue and outlawry, likely to provoke international complications any day. Americans and other foreigners are coming out of the mining centres, even in the North, from Mapimi, Parral, Chihuahua, for example. Everything is closed down at Guanajuato, for lack of supplies. El Oro and Pachuca are in the same plight. For a time the mines were allowed to be operated because they produced the bullion on which tribute could be levied by the various brigandages masquerading as governments.

Now the mines are to be despoiled. The mining operations heretofore persisting in northern Mexico, under the uncertain patronage of Pancho Villa, are now definitely at an end. That is about the only result of the A. B. C. and B. U. G. conferences. Meanwhile one significant incident may be recorded. The payment in silver made to the workers at Cananea has had the effect of drawing many from Villa's army. We believe that the establishment of a compromise government and the offer of *dos pesos por dia*, not in paper but in silver, to those joining a Federal army for policing the country would go far toward terminating a condition of chronic devastation. But to do that requires funds, not to be obtained without the recognition of our Government. No exterior Mexican loan can be made without such recognition. Amid the confusion of the last two years one result at least has emerged, and that is the financial suzerainty of the United States over the territory south of the Rio Grande. Through that power, exercised for the good of Mexico, without territorial aggression, and for the purpose of restoring order, will come a solution of the problem that has faced the Administration at Washington since the murder of Madero on February 22, 1913.

Ore-Stealing

The finding of $25,000 worth of gold ore in the possession of a man who was recently a 'specimen-boss' in the Empire mine, at Grass Valley, draws attention once more to the thieving that is half-condoned by being called 'high-grading.' As most of our readers are aware, in the mining of quartz veins that contain coarse gold, called 'specimen ore,' it is customary to detail trustworthy men to visit the stope-faces where such gold is visible and remove the rich ore in sacks. These men are called 'specimen-bosses.' In the case in question we have an example of confidence misplaced. One of the worst cases of ore-stealing at Cripple Creek was perpetrated in a similar manner, the foreman in the sorting-house being in collusion with a gang of thieves. The evil is as old as mining. So is the confusion between right and wrong that is at the basis of it. This form of petty larceny begins with the notion, among otherwise respectable miners, that there is no harm in pocketing an occasional specimen; just as there is a kind of tourist that thinks it not improper to purloin an occasional spoon as a souvenir. From a single specimen to a sack-full of rich ore is merely a matter of gradation. The Western miner who would regard a bullet as the proper sequel to the theft of a horse will smile at the stealing of enough gold to buy a herd of horses. The fallacy is ancient. In the records of Guanajuato we are told how Antonio Obregon built the church of Valenciana by persuading the miners to donate the ore they stole to this worthy cause, placing the larcenous portion of mineral on a quadrangular area especially set aside for the purpose. In later days we have the case of the alluvial gold mines of the Bodaibo, in Siberia, where the peculation of gold is officially recognized by the company operating the Lena Goldfields. In one year, namely 1913, the company paid $414,395 for gold stolen by its own employees. That sum of money, of course, did not represent anything like the full value of the gold. It was ransom. Owing to the isolation of the mines, the workmen are not able to get away with the gold, so that this regularization of theft is deemed expedient. In some gold-mining districts the stealing of ore has become a well organized business, aided by illicit buyers, unchecked by the police, and feebly condemned by the local courts of law. That is the story of Ballarat and Bendigo, of Cripple Creek and Goldfield, of Kalgoorlie and Grass Valley. The chief agent in the chain of criminality is the illicit buyer, disguised as an assayer or a sampling-works. The trade is lucrative. Those who try to stop it are hampered by a loose, if not perverted, public opinion creating a sneaking sympathy with the poor miner who takes his small share of the mine-owner's big profit. Besides such spurious sentiment there is the self-interest of the mining community. Those who make money in this nefarious business are prone to the spending of it freely in the saloons, gambling-houses, and other places. This helps local trade, while the gold that reaches the legitimate owner is likely to be spent far from the place of its origin. Hence convictions in local courts are difficult. In a notorious case at Cripple Creek, several years ago, a judge decided that the stealing of ore was not petty larceny because mineral was real estate. In that rich district the 'fences' or illicit buyers became so numerous in the bonanza days that many of the so-called assay-plants were dynamited, with the connivance of the mine-owners, during a period of labor disturbance. Thus one crime was perpetrated to check another. Indeed, the ineradicable lawlessness of undisciplined man is at the bottom of it all. The labor-unions wink at the evil. The public fails to see it in its true light and even forgets that it is not the miner, but the go-between or 'fence,' that makes most of the profit. Judges and juries are lenient, the punishment usually meted being quite inadequate as a deterrent. The idea that the stealing is done only in mines yielding big dividends serves as a sop to the feeble-minded moralist; but, as a matter of fact, much of the 'high-grading' is perpetrated in mines in which the average yield is low, although occasional rich spots in the vein or lode facilitate theft. The only cure is the recognition of facts and the discarding of an unhealthy sentimentality on the part of the public. What is needed is more respect for law and a better recognition of the distinction between *meum* and *tuum*. To effect that we must begin by calling things by their right names, replacing such euphemisms as 'high-grading' by 'theft,' and 'specimen-hunting' by 'stealing.' Whether it be a rich mine-owner or a small operator from whom gold is stolen, whether it be a hotel or a private house from which a silver spoon is purloined, the wrong done is equal, and no sophistry or sentimentality will change the fact. The wrong is not so much to the owner as to the community, whose code of conduct is flouted, whose sense of right is undermined.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Relative Error in Alluvial Sampling

The Editor:

Sir—Under the above heading Mr. Charles S. Haley published an article in your issue of July 17 dealing with the various sources of error to be considered in sampling gravel deposits by drilling or shaft-sinking. While agreeing with him in a large part of his statements, there are a few points, which should be of some importance, upon which I most emphatically disagree with him.

In discussing the measurement of the core when drilling with a Keystone drill, he says that it "is absolutely incompatible with making any speed" to measure each pumping, and further, that "the usual practice is to measure up only when the sluice-box begins to get full or nearly so. So you do not have the core that you should have for your drive, and you don't know how much of the core you have saved." In considering drilling with an Empire hand-drill, he says "the total core for the drive may readily be measured up and checked with the theoretical core without cutting down the speed of drilling. In this case, a flexible system of keeping the log is applicable such as is impossible in the case of the Keystone."

My first objection to Mr. Haley's article is that for an engineer who insists so strongly upon the use of judgment, he is strangely anxious to develop speed at the expense of accurate and dependable results. I have had considerable experience in the use of each of the drills mentioned, and in the light of that experience contend that it is possible to measure the core for each pumping with a Keystone drill without appreciably lessening the speed of drilling. Also that it is possible to apply to the Keystone any system of keeping the log that may be employed on the Empire. Moreover, because the volume of core is much greater in the case of the Keystone, instead of the chances for error in measurement being greater, they are actually smaller. This is one of the principal advantages which the power-drill possesses over the hand-drill, and is, I think, the prime reason why it is preferred by most engineers wherever its use is possible.

I shall describe, as briefly as possible, a method in use by which the core for each drive may be measured without necessarily sacrificing accuracy for speed, and also the method of calculation by which the core measurements may be used to correct the weighed amount of gold for the hole.

The pump is emptied, and washed, into a tight sluice-box that can be drained and washed, into a bucket set under the lower end. After settling for a moment in the bucket, the water is drained off through the rocker by the simple process of tipping the bucket to one side on the rocker-screen. A good bucket to use is the standard 16-quart galvanized iron bucket, the dimensions of which are: top diameter, $12\frac{3}{4}$ in.; bottom diameter, 9 in.; depth, $9\frac{1}{4}$ inches.

The water being drained off, a straight piece of wood is laid across the top of the bucket, and the distance is measured between the lower edge of the wood and the top of the pumped material in the bucket. The material is then rocked as usual and the gold is saved after counting the number of 'colors' of each size. After a little experience in any particular district, it is possible to have the panner divide practically all of the gold recovered into three sizes, called No. 1, 2, and 3, in such a manner that on an average ten No. 3 colors will approximately equal one No. 2 color, and ten No. 2 colors will likewise approximately equal one No. 1 color.

The material passes from the rocker into an accurate measuring box, of $\frac{1}{2}$ or 1 cu. ft. capacity, and the slime passing over is caught in a square hole where it is settled, so that all of the material washed can be measured and used as a check against the bucket-measurements.

The panner is now ready to note results. He first consults a prepared table, one column of which gives the depth by half or quarter inches from the top to the bottom of the bucket. In a column opposite is given the proportion of the material filling the bucket to any depth, as compared with the required core for one foot of drive. For instance, at $1\frac{1}{2}$ inches down the proportion is 1.44; at $4\frac{1}{2}$ inches down it is 0.78; and so forth. Of course these proportions are not absolutely correct; they depend upon the character of the ground drilled. There will be a large run-off of slime in clayey ground, and broken coarse gravel will measure more than sand for the same depth of drive. It does give a much more definite basis to work upon than the drive-shoe cross-section multiplied by the depth of drive, especially in tight ground where the actual pumping will sometimes be not more than one-third or a half the theoretical core, or in running sandy ground where the pumping is often several times too large.

After finishing a hole, the gold is amalgamated with as small a quantity of quicksilver as will readily take up all of the gold; it is then bottled, labeled, and turned in with the log to the engineer in charge. He dissolves the quicksilver with dilute nitric acid, then washes,

dries, anneals, and weighs the resulting clean gold, preferably getting the weight in milligrams.

The record for the bottom few feet of a purely imaginary drill-hole is given for purposes of illustration. Referring to it, we find that for the 28th foot in depth we have 0.3 too much core, the next two feet have the correct amount, while at 31 and 32 there is not enough core. For the remaining fraction of a foot there was obtained 0.8 of the correct amount of core for a 1-foot drive. Inasmuch as the drive was only 0.7 of a foot, the core-ratio is really 0.8 divided by 0.7, or 1.14. We may now calculate the correct weight of gold for the hole, as in the table below. The corrected colors column is obtained by dividing the core-ratio into the number of colors actually counted.

Depth.	Colors.	Core ratio.	Corrected colors.
28	10	1.30	7.7
29	15	1.00	15.0
30	30	1.00	30.0
31	60	0.90	66.6
32	75	0.67	111.8
32.7	170	1.14	149.1
	360		380.2

The corrected weight therefore is $\frac{380}{360}$ by 180 or 190 milligrams, and the value per cubic yard for the hole may be figured from this weight.

It is not claimed for this method that it will give absolutely accurate results. There are too many variable factors in the problem for that. For instance, the material in each foot driven usually swells to a different degree when broken into pieces of varying sizes; the amount of slime not measured will vary greatly with each individual foot; there is a large and inevitable personal factor in the estimation of the comparative sizes and counting of the colors; and so forth, indefinitely.

The method will, nevertheless, determine within narrow limits whether or not the proper amount of material is being extracted for each foot driven. If the operator does not care to go to the trouble of making calculations similar to those given for each hole, he at least has a double check upon the amount of material actually rocked, and a very fair idea as to whence it came.

R. H. Elliott.

Sloat, California, September 6.

Deflection of a Diamond-Drill Bore

The Editor:

Sir—I notice in your issue of September 4 an article on this subject by Ernest T. Preston. This article illustrates clearly the extent to which a drill-hole may deviate from the vertical and the importance of drill-hole surveys. It is much cheaper to survey a drill-hole at the time it is being drilled than to wait until later when a drill outfit has to be moved in especially for the survey and when there is sometimes difficulty in recovering the drill-hole. You may know of the trouble that the Indiana Mining Co. is having in the Copper Country of Michigan in finding underground a hole drilled from surface several years ago. Their shaft failed to find the ore where it was expected and a great deal of money has since been spent trying to find the drill-hole, without success. In this case, the standpipe from surface to lode had been pulled and as the depth is several hundred feet, it is impossible to recover the hole. A correct survey at the time the hole was drilled would have saved much money.

It is possible that the difficulty Mr. Preston had in getting his compass-readings to check was because the needle sometimes touched the side of the glass containing the jelly. I believe in the early compass-tests made in South Africa and Australia the needle was not protected in such a way that it could not touch the glass. The Cleveland-Cliffs Iron Co. has been using the Maas compass for this purpose since 1910 and has had no difficulty in getting accurate readings. This compass is also used by many other companies in Michigan that are now making a practice of surveying all their drill-holes. We find that inclined or flat holes often change direction and inclination just as rapidly as vertical holes. Since 1910, the Cleveland-Cliffs Iron Co. has made about 1000 separate tests for inclination and direction in drill-holes. Gelatin is used for the jelly and this has proven very satisfactory. We have tested holes to a depth of 2500 ft. by this method. Agar jelly would undoubtedly be an advantage when the drill-water is very warm, but in this country it is usually below 60° F. Under these conditions, Agar jelly would probably set too quickly.

E. E. White.

Ishpeming, Mich., September 9.

[We, and our readers, are much obliged to Mr. White, who is chief geologist to the Cleveland-Cliffs Iron Co., for this useful and timely information.—Editor.]

The Cost of Radium

The Editor:

Sir—On page 406 of your issue of September 11, it is stated that "The fact that the Bureau of Mines has reduced the cost of producing radium to $36,050 per grain of bromide will perhaps make a visit to the radium booths interesting." Assuming this statement to be correct, except for the supposedly typographical error, which substitutes "grain" for 'gram,' we are again subject to the skilful exaggeration which the Bureau used so successfully in its campaign against the radium-producers early last year. This statement, in connection with the fact that radium was selling for $120,000 per gram, is supposed to indicate either exorbitant profit for the so-called but mis-named radium Trust, or else very superior results by the metallurgists of the Bureau. Is either conclusion fully warranted? The price at which radium is sold is given in terms of the radium element, whereas the cost that you report is given in terms of the salt, radium bromide. In spite of the general use of the amount of the element as a standard in

measuring radium by those most familiar with the business, and most interested in disseminating precise information, many persist in using the obsolete basis of radium bromide, frequently not even taking the trouble to qualify the statements made by using bromide, but speaking only of radium, when radium bromide is intended. How long would we tolerate the use of the term lead instead of galena, for instance, by any intelligent and educated man? Yet an analogous situation with regard to radium goes almost unchallenged. Pure radium bromide ($RaBr_2.2H_2O$) contains 53.6% of radium element, which makes the cost of producing radium by the Bureau, when expressed in standard terms, $67,257 per gram, which is "something else again." Until the Bureau makes public the details that make up this cost in order that we judge as to whether the cost of developing the process has been properly included, and what other items are or are not included, we can hardly, in fairness, consider that it has made out a clear case in favor of its contention, when all the diverse factors entering into this delicate process are given full weight. Is the price of radium exorbitantly high for the product of a new industry?

L. O. Howard.

Salt Lake City, September 13.

Mining and Milling in Wisconsin

The Editor:

Sir—I wish to call your attention to an error, probably typographical, which occurs in your issue for September 4. In the article by Clarence A. Wright on 'Mining and Milling in Wisconsin,' it is stated that following the rolls there are trommels "with 1½-in. holes." Undoubtedly ½-in. holes was meant, for that is the usual opening for this district. In many mills $\frac{7}{16}$ and ⅜-in. holes are used, but in no case does a coarse 1½-in. feed go to the jigs.

Paul R. Fanning.

Platteville, September 14.

Publicity and Advertising

The Editor:

Sir—Without pretending to be an authority on the subject, I offer the following suggestions as to advertisements in technical journals apropos of your article on this subject. It would seem as though there were three legitimate purposes to a page or half-page advertisement. First, it is necessary to catch the eye. Secondly, there should be some information imparted for the benefit of the thoughtful reader. Thirdly, somewhere in the wording or picture should be a phrase, idea, or impression which will linger in the reader's mind.

Many advertisements appear to have achieved all they want if they merely catch the eye, and arrest a reader's attention for a second or two, without his exactly knowing what product is being advertised. Such advertisements may show a cannon or a duck or an aeroplane glaringly displayed. The reader looks at the cannon, duck, or aeroplane, yawns—and turns the page. Now, while such startling and thrilling pictures of such curious objects are mildly interesting, it is obvious that the writer of a technical article in the journal proper would never think of coaxing the reader's attention by such a method. While it is apparent that more leeway should be allowed an advertiser (of the Thomas W. Lawson type or otherwise) in spectacular display and license, it is rather beyond my ken just how an aeroplane helps to advertise, say, a mine-pump or a special brand of belting. I admit that a skilful journalist might consistently utilize an unusual or popular picture to draw attention to goods that really had some connection with the article in question, either in use or in appearance and name. For instance: butterflies and butterfly-valves. But in many cases such connection or similarity is so far-fetched and artificial as to approach the nature of a farce.

I have looked at an advertisement showing a photograph of a machine operating in Alaska, in South Africa, or in China, and been struck by the oddity or attractiveness of the scene. The next thought is "Why does not the company append a brief description of that particular job; certainly it would be interesting to read of what was done, and how it was accomplished, the difficulties, dangers, and ways-out that were part of the work?" Yet it usually happens that when an advertiser does add a description of work accomplished it is a bristling mass of formidable data so poorly arranged as to encourage the thought that the office-man who compiled it did not know what the figures meant.

It is my private but convinced opinion that the reason why technical advertisements display such a lack of brains is because the man who is deputed to write them has everything necessary except the brains. Like the editorials of some city newspapers, technical advertisements appear to fall to the lot of cub-writers who may know something someday but who are starting poorly. Considering the immense amount of money expended on advertising, the question arises as to why manufacturers and selling agencies do not appreciate the fact that a thousand dollars spent on advertising-space accomplishes many times more results when a hundred dollars worth of intellect is combined with it, than the same space plus a half-hour of a high-school boy's brain.

But it is not meant to imply that all technical advertisements are dull and poorly written, or that all advertising managers are shy of brains and understanding. Many advertisements are excellent; some advertising managers are keen discerning fellows who see clearly the point of view of the men at the mines. Allowance must be made for the fact that sitting at a desk in a New York office looking at sky-scraper roofs on a routine of eight hours a day is not the best condition for originality or spontaneously clear thinking. Working with a lead-pencil in a cramped room among numerous clerks and paraphernalia is not exactly conducive to sensing the atmosphere of the mines.

P. B. M.

New York, September 18.

The Mining Engineer

By WILLIAM L. SAUNDERS

*It is said that the last words of William IV, on hearing the sound of cannon on the anniversary of the Battle of Waterloo, were: "That was a great day for England"; and so as the members of this Institute look out upon this great Exposition and see and hear what California, a mining state, has done in but little more than half a century, we may perhaps be pardoned for exclaiming with joy and pride: This is a great day for the Institute of Mining Engineers.

We are glad to be here, we are glad that we are alive; happy in the thrill of vitality which is quickened by California spirit and by the elixir of your glorious climate. On behalf of the Institute which I represent, I thank you for giving us this day. In thus honoring the Institute you are paying a tribute of regard and appreciation to the whole mining industry; to the lusty pioneer who blazed the trail and whose dry bones were the only monuments to mark the milestones of his progress; to the educated engineer and the capitalist whose skill and money were spent beneath the soil in daring efforts to release the hidden forces of Nature and put them to the service of mankind. You are paying tribute to the geologist, the chemist, and the metallurgist, for they, too, are mining engineers and members of this Institute.

I speak of California as a mining state; as such were you born. You received your baptism in the waters of the South fork of the American river when Marshall discovered gold at Sutter's mill in 1848. This was the beginning of the Golden Age for California and the world. The Golden Age means more than the age of gold; it is the age of progress, of prosperity and industrial renown and wealth; the age of railways and steamships, of manufacture of steam-engines, and of electricity, of the telephone, telegraph, the automobile, and the aeroplane. All these things were made possible—yes, they were initiated and installed—through means which were afforded by the mining industry. The mining engineer has multiplied and replenished the earth through subduing it; he has released those forces of nature which have been hidden through countless ages; he has through the science of metallurgy and chemistry made it economically possible to widen and enlarge to enormous proportions the use and influence of these forces. Look into the modern locomotive and steamship and we shall see that almost every pound of their vital structure is a product of the mines. The lathe that fashioned the shaft is itself a product of the mine, and it gets its power to turn from coal mined by machines which are themselves products of the mines. Lest you say to all this that the art of mining is as old as the hills; let me remind you of the fact that mining at low cost, mining low-grade ore, and doing these things on a large scale, and the art of reduction and treatment through metallurgy, are the accomplishments of the mining engineer of our time. This was the key which unlocked those forces which have been the impulse behind the great industrial progress of the world. This, too, has all been accomplished since the discovery of gold in California.

Let us review some of the facts of history. The first half of the nineteenth century was a period marked by little progress in industrial wealth. The world's output of gold from 1800 to 1835 varied from ten to fifteen millions of dollars annually. The yearly product of iron during this period was only between two and three million tons, coal less than fifty million tons, copper less than fifty million pounds. There were no transcontinental railways, no great steamships, no battleships, no factory system of manufacture, no large corporations. The total gold product of the United States during the period mentioned scarcely reached one million dollars annually. Beginning about the middle of the century, when California set the pace by adding in a single year fifty, and even eighty millions of dollars to the gold of the world, there followed a steady and increasing progress made in the output of iron, coal, and copper. Railway building progressed on almost parallel lines; so, too, did the deposits in the banks of the United States. It is of interest to note here that the American Institute of Mining Engineers got aboard in 1871 and thereafter shared closely in growth and prosperity this march of industrial progress.

The world's production of gold at the present time is over $450,000,000 annually. The United States alone now produces over 26,000,000 tons of pig-iron annually, and about 550,000,000 tons of coal. The world's yearly production of copper is now over 900,000 tons, and of this the United States produces over 500,000 tons. So, too, we find that the average per capita wealth of the people of the United States has risen from $300 in 1850 to over $1300. The influence of mining on wealth is conspicuously shown in the case of your neighbor, the State of Nevada, where the per capita wealth of her people is about $4800. Nevada is, strictly speaking, a mining state, with easy divorce laws to interest and allure the homeless and distracted mining engineer.

California has added more than $1,600,000,000 to the gold supply of the world. Her record average of over $25,000,000 in gold annually for 50 years is unprecedented. It has been estimated that the actual value of

*Address delivered by the President of the American Institute of Mining Engineers, Panama-Pacific Exposition, San Francisco, September 17, 1915.

gold deposits should be multiplied eight times to get the true value in credit and capital: If this is true, then California has in her gold supply alone contributed over $12,000,000,000 to the capital wealth of the United States.

Gold is the standard of all values. It is the measure of credit, the basis of exchange. "Change and decay on all around I see," but in gold there is no change, no decay. The lure of gold has discovered continents and turned deserts into fertile lands. Gold was the beacon-light which led Columbus across the Atlantic. Cortez, Pizarro, Balboa, and others who are called explorers were really pioneers and prospectors whose voyages led to the early development of mining in Peru and Chile. But not till California led the way did the mine explorer become a world builder; he was the advance agent of prosperity.

The stability of this country in peace and in war is due mainly to the mining engineer. Our industrial strength comes from the mines, the mills, and the furnaces which are now so well organized on a peace basis and which have in their substance all the sinews of war. Military supremacy comes from the same elements as industrial supremacy: It is mainly a question of organizing the resources of the country. Of one thing we may feel sure and that is that no nation can ever make a scrap of paper out of a gold eagle.

> You may crush, you may shatter the coin if you will,
> But the value of gold-dust remains with it still.

It was because of the recognized importance of the mining and metallurgical industry that the American Institute of Mining Engineers was organized at Wilkes-Barre, Pa., in 1871. Following the War of the Rebellion and coincident with the development of the mining industry in the far western states, there arose a great demand for mining engineers. It was recognized that the chief factor in the development of the Western country was the mining industry: It created a romantic interest and it gave a stimulus to the people in general and even to Congress, which granted large subsidies for railway building. Scientific schools were established and technical journals disseminated engineering literature; but the mining men, those actually engaged in the mines and mills and smelters, were not organized: They needed a common ground for the exchange of ideas, a forum for discussion and education; and so the Institute was established. It was the second society of its kind following the organization of the American Society of Civil Engineers. The Transactions of the Institute cover geology, assaying, milling, smelting, mining, quarrying, and general construction management. The papers submitted at the meetings cover a wide field and are recognized by engineers and scientists throughout the world as of significance and value.

The Institute is incorporated under the laws of the State of New York, organized and existing with the object of promoting the arts and sciences connected with the economic production of the useful minerals and metals and the welfare of those employed in these industries by means of meetings for social intercourse and the reading and discussion of professional papers, and to circulate by means of publications among its members the information thus obtained. Its membership includes those who have worked their way up from the ranks as well as graduates from scientific schools and colleges. Leading professors and technical educators have always been prominent in its membership. The welfare and safety of the mine-workers is a subject of recent and earnest interest among the members, and a new field of usefulness has been developed in using the power and the influence of the Institute wherever the industry represented by mining and metallurgy or the people engaged in the work may be benefitted through state or national legislation.

On behalf of the members of the American Institute of Mining Engineers, numbering now over 5000 and scattered throughout the world, I extend to President Moore, to San Francisco and to California, a full measure of warm congratulations and our best wishes for continued and increasing health, happiness, and prosperity.

Canada is practically the sole producer of cobalt ore; the cobalt content of the ores mined in the Temiskaming district, Ontario, exceeds 2,000,000 lb. per year. The market for this, at present, depends altogether on its limited use as a blue coloring substance. Hence there is a large accumulation of cobalt oxide at the smelters and at Cobalt. Under present industrial conditions, the smelters refuse to pay for the cobalt and nickel content; consequently, the miner receives nothing for this valuable constituent of the ore. Yet the metal cobalt resembles nickel in almost all its properties. Its density, malleability, ductility, hardness, tensile strength, and electrical properties are, so far as they are known, very similar to those of nickel. These properties of nickel make it of remarkable industrial value in the composition of a great variety of alloys. Of these may be mentioned the high-grade steels, where toughness and hardness are desired: for automobile parts, steel tubes, gun steel, cranks and crank-shafts, boiler-plates, tires, connecting-rods and axles; the nickel-iron wires such as 'invar' and 'platinite,' with low temperature coefficients of electrical resistance and of expansion respectively; and the variety of important nickel alloys with non-corrosive properties, for coins, boat propellers, etc. It would be surprising if cobalt could not be advantageously substituted for nickel to produce a better grade of some of the above products. As these are high-grade products, where superior qualities are desired, a high cost, within certain limits, would not be prohibitive. Hence, if research leads to the substitution of cobalt for nickel, even in the case of one of these products, a market for the metal cobalt at a reasonable price would be assured, and large sums of money would be annually added to the returns from Canadian natural resources.

Danish pebbles are considered the most economical of all tried at the Tonopah-Belmont mill.

The Cornish Miner in America

By P. B. McDONALD

Three or four miles southwest of Ishpeming, on the Marquette Iron Range, is the old Saginaw mine, idle now for 35 years. Once it was a lively producer, but the hard-ore 'vein' pinched out, and the old place looks a wreck. During the long period of neglect, various 'squatters' settled on portions of the extensive property and acquired little farms. A few years ago, when the attention of mining men on the Iron Ranges was being directed toward finding soft-ore concentrations in the lower horizons of the iron formation, the company by which I was employed bought the old Saginaw mine. I was sent to the mine on a surveying and geological reconnaissance. The most likely place to stay appeared to be at the self-appointed watchman's cottage, where lived 'Garge' Blee, a little Cornishman of some local reputation, who had worked in the mine forty years before. He was a character. With his wife he had resided at 'the Corners' for years, and he was familiar with all the history of the mine—except the essential points I wanted to know, which he had forgotten. But he overflowed with anecdotes, reminiscences, and dialect —mostly dialect. He was so typically a Cornishman and 'Cousin Jack' that he put all the others I had seen in the shade. His *pièce de résistance* in the conversational line was the recounting of his extraordinary exploits as a wrestler in the Cornish style when he had been young and his joints supple. According to his way of telling it, he must have been *some* wrestler in his day, having apparently "throwed" every Tom, Dick, and Harry in the Michigan mines. I particularly remember his account of how he overcame a great bully of twice his size by catching him on a slippery path and heaving him over his head with the 'flying mare' (" 'eaved 'im hover my 'ead," he said) so that the big fellow came down powerful hard on his ear and the back of his neck.

The old man could tell strange tales of early days at the iron mines; of gigantic air-blasts underground that blew the miners over like nine-pins; of marvelous driving accomplishments on contract when he and his partners reaped rich gains from their prowess at swinging hammers and twisting drills, being able to hit left-handed, right-handed, or in tight corners where modern miners could not operate; of terrifying shaft-sinking jobs when dire catastrophes happened daily; of cave-ins, falls of ground, floods of quicksand, mine-fires; of how the bottom of a river dropped into a stope and drowned the miners; of losing the 'vein' and how he (Garge Blee) found it again, when the whole mine-force was nonplussed; of famous old miners and foremen, Captain Bill Oliver, Captain Dick Trebilcock, and Captain 'Arry; of queer incidents and complications at the mines, that were all the queerer in his telling of them; of how a famous old captain in the copper country once paid his men off in native copper when the money for the pay-roll failed to arrive and the miners called for their wages.

Blee's little farm had the characteristic disorder of a Cornish homestead. He kept a horse (an 'arse he called it) a cow, a pig, chickens, ducks, guinea-hens, and several other species. I pleased the old man by taking his picture surrounded by his eight or ten dogs, and again one evening when he was milking his cow. He talked a whole day of how a neighboring farmer was threatening to sue the company for the loss of a bullock that had fallen into an old exploration-shaft, but he proved (by showing me the shaft) that the offended farmer must have "pushed the bullock in." One of the squatters, the most "no account" of them all, was named Sam Bennetts. This shiftless man was very proud of his dozen young sons, who were growing up some way, in spite of scarcity in the flour-barrel and of salt-pork at Sam's house. He was proudest of one who was away at the Reform School, which the father considered in the light of a college education. There were two reasons why Bennetts had never written to his absent son; he had lost the newspaper giving the account of the matter with the address of the reformatory and he never had had a stamp.

Cornish miners have a remarkably thorough understanding of mining. They are not in the business until they can get something better to do, nor as dilettanti, nor half-heartedly, but as men who take mining and underground-work seriously. They are as much at home in a dark 'scrambly' old stope, or at the face of some interminable drift, or in a stuffy underground pump-room, as a machinist in a machine-shop. They know underground things instinctively and look upon mining as a natural calling, much as a sailor looks upon the sea. Some superintendents do not like Cornish miners, saying that they are headstrong (which is true) and disputatious (which may also be true). But, when properly handled, as at certain mines in the Lake Superior region, Cornishmen make very steady, satisfactory, and capable miners. They are not so docile as southern or eastern Europeans, but they know more, are dependable, and are ingenious and go-ahead workmen.

There are a good many Cornish miners and foremen (or mining captains) both on the Iron Ranges and in the copper country. The numerous and ingenious stoping methods evolved in the Lake Superior mines (whereby shoveling is nearly obviated, timber is diminished, and safety and ease of handling the ore are strikingly attained) have been largely due to the underground ability and understanding of the Cornishmen. It is an innate Cornish principle to use one's head in mining; hence the labor-saving systems by which ore is stoped down in large masses to fall directly into chutes for loading into tram-cars. From the Lake Superior region, Cornish miners and their praiseworthy mining methods have spread to all the districts of the West. It is also interesting to note that from the ancient tin mines of England's southwest corner, Cornishmen have followed the call of the pick and drill to the ends of the earth—South Africa, Australia, America, East, West, North, and South.

LOADING WITH HORSES AND SCRAPERS.

TRAIN OF ORE-CARS.

Mill of the Big Four Exploration Co., Utah

By L. O. HOWARD

Introductory. For many years the accumulation of various tailings in the Park City district, Utah, has held interesting possibilities. All the mills of the district have been situated at Park City or in the canyons south of the town. Tailings have been distributed over a distance of at least nine or ten miles. In the two miles of steep canyon above the town there has been little accumulation. Just below, however, is a flat on which a small amount has collected, and been subjected to re-treatment. A mile below the town in Silver gulch is a large accumulation now the object of treatment by the Broadwater Mills Co. in a 500-ton wet concentration and flotation mill, at present under construction. It is estimated that 450,000 tons is available here. Farther down the canyon are several smaller accumulations in the flats where smaller plants are at work. Seven miles below Park City, at Atkinson, is the deposit now being exploited by the Big Four Exploration Company.

In the earlier days of milling in the district little attempt was made to save the zinc minerals, and even as late as 1913, recoveries of zinc were low. Only now are they at the point of being bettered. For instance, weights and assays published in the report of the Daly West Mining Co. for 1913, this company being the only one of the three large operators to publish the assay of the second-class ore fed to the mill, indicate a recovery in marketable form of only 22% of the zinc in the ore. It is doubtful if others are doing much better. Making due allowance for the zinc contained in lead concentrate, and hence not available for operators on tailing, and for the fact that previous to the impounding of tailing in recent years, the zinc in tailing has run progressively higher the nearer we approach the early days of milling, it is evident that the accumulation of tailings for many years has resulted in a product that is attractive for its zinc content.

The milling-ore has consisted of galena, pyrite, chalcopyrite, and sphalerite in a quartz gangue, the lead, copper, and iron sulphides containing a large proportion of silver and some gold. Prior to the last decade the problem in concentrating has been "to save the galena and pyrite, together with any chalcopyrite and tetrahedrite which may be present and to throw out silica and all the zinc-blende in excess of the allowance."* The first mills, built in 1874, were stamp-mills. In 1875 four

*Professional Paper No. 77, U. S. Geol. Survey, page 27.

MILL AND TRANSFORMER STATION, AT ATKINSON, UTAH.

mills, using 80 stamps, were running. In 1877, at the Ontario mill, the ore was dry-crushed, given a chloridizing-roasting, and amalgamated in pans. In the early 'eighties the Russell lixiviation process was developed, from which there was, of course, but little sulphide tailing. In 1878 the first concentrating machine—the McKim—was put in operation in a mill near the Marsac, in the city limits. This machine had some resemblance to the early Frue vanners, which later were used here. In 1889 the first modern concentration plant was erected and wet concentration has since been the general practice, with the exception of the brief periods in which magnetic separation, dry table-separation, and the more recent chloridizing-roasting and leaching process, were in vogue.

Zinc was not as prominent a constituent of the ore in the upper workings as it soon became in the deeper stopes, especially in the fissure type of deposit. In the 'nineties the zinc problem was first recognized. In the concentrating ores zinc was present in amounts from 6 to 10%. With a specific gravity near 4, in an ore containing pyrite of specific gravity 5, galena of specific gravity 7.5, and chalcopyrite of specific gravity 4.1 to 4.3, difficulty was inevitable in making a satisfactory saving of the zinc.

There are now at least six plants, large and small, treating the tailing from the Park City mills, in wet-concentration plants. Part of these treat current tailing, namely two above the town, which make a good recovery of zinc and lead on Wilfley tables in simple little plants. Below the town I observed four plants in operation on accumulated tailing, producing remarkably good-looking lead and zinc concentrates. Shipments from all these amount to 500 tons monthly.

The Ore. The portion of these tailings, now so thoroughly mixed as to be fittingly labeled 'tailing,' that is under lease to the Big Four Exploration Co., lies seven miles below Park City at Atkinson. It covers an area 3½ miles long, and 500 ft. wide. The depth averages 2 ft. The amount available for milling is estimated at over 1,000,000 tons. Samples taken every 100 ft. along the flat indicate that the average metal-content of the tailing is as follows: Lead 1.8%; zinc 4.1%; silver 3.1 oz. per ton; gold 30 cents per ton; iron 2.5%. The silica amounts to 62%.

At present the tailing is being drawn into heaps beside an industrial railway by the use of eight or ten teams with scrapers. From these heaps the tailing is scraped over a plank-way bridging the tracks and dumped into 4-ton contractor-cars. Trains of four cars are hauled one mile to the mill by a 'jitney,' a converted 1911 Cadillac touring-car provided with flanged car-wheels, at the rate of 8 to 12 trips per 9-hour shift. The return trip now consumes much unnecessary time, since the car is only capable of the usual reverse speed. This drawback will be eliminated by the addition of a reverse gear that will permit the same speed backward as forward.

Upon arrival at the mill the cars are spotted over a 6 by 7-ft. grizzly having 4-in. spaces between bars, which are 2½ in. deep and ⅝ in. thick. All coarse foreign matter, such as wood, boulders, etc., is here removed.

The tailing falls into a pocket, 6 by 7 by 4½ ft., made of $\frac{3}{16}$-in. steel plate, which feeds a 16-in. belt-conveyor. This carries it 140 ft. up an incline of 24° to the top and far end of the mill. The belt travels at a speed of 206 ft. per min. In Fig. 4 the unloading-shed is shown at the extreme left, connected with the mill-building by the conveyor-shed.

Flow-Sheet. The mill-building is 73 ft. long and 56 ft. wide by 40 ft. high, of frame construction, covered with tarred paper. The site is flat, requiring the use of five elevators. There are four main floors. At the top are the waste-trommel, distributing belt, and waste-belt. On the third floor are the jig-trommel and Callow screen. On the second are four roughing Wilfley tables, two coarse and two fine jigs. On the bottom floor are two finishing Wilfleys for concentrate and five for middling and the re-grinding mill. In a tower on the roof is the water-supply tank.

The tailing is discharged from the incline conveyor to a waste-trommel, 4 by 6 ft., covered with double-crimped wire-cloth screen having ½-in. apertures. Screening is done dry, all material over ½-inch in size being discarded to an 11-in. reject-conveyor, running over a trestle outside the mill to a waste-dump.

The undersize of the ½-inch screen falls upon a 14-in. distributing belt which delivers to a V-bottom storage-bin, 12 by 32 ft., by 16 ft. deep, having a capacity of 4600 cubic feet, or enough for four or five shifts. This bin is filled in one 9-hour shift.

In order to avoid being impaled upon either the ambiguous or the prolix horn of the dilemma, it becomes necessary at this point to clarify our use of terms. 'Ore' will be used when referring to the untreated tailing that is the object of milling, reserving 'tailing' for the waste-product of machines or of the mill as a whole.†

The ore is drawn from the bin, with the aid of a stream of water, to the boot of the main elevator, by which it is lifted 30 ft. to another trommel, 3 by 6 ft., covered with double-crimped wire-cloth screen having ¼-in. apertures. Below the trommel is a 16-mesh Callow screen. Three sizes are thus made for the primary concentration, as follows: through ½-in., on ¼-in., through ¼-in., on 16 mesh; through 16 mesh. The coarse is treated on two 3-compartment Harz jigs, and the medium on two others. Jig-screens are 17 by 32-in. double-crimped wire-cloth, 8-mesh on the coarse and 10-mesh on the fine. Both sets of jigs are used as roughers, making a large amount of low-grade concentrate from hutches and side-draws, and sending the tailing to the creek. The jigs are old equipment brought from Idaho and have not worked satisfactorily. Nothing about them appears to be right. A heavy vibration is set up, eccentrics bind, beds do not form properly, boils are constant, and hand-skimming of the bed is necessary every 15 minutes. A few days' operation of the mill has shown the necessity for new jigs, and they are to be erected.

The fine is also subjected to a roughing treatment on

†[This is quite correct. The old 'tailing' becomes crude ore to the man who is treating it *de novo*.—Editor.]

four Wilfley tables. These discard tailing to the creek and make a mixed concentrate, which is treated on two Wilfleys for a lead and a zinc concentrate, and a middling, which is combined with the middling from the roughing tables.

The middling from the jigs is settled in two superimposed boxes, the coarsest and heaviest portion being re-ground in a No. 43 Marcy ball-mill. The overflow from the first box is by-passed around the mill; the overflow from the second goes to the main elevator and re-enters the circuit.

The discharge from the ball-mill is passed over a 10-mesh screen and the oversize returned to the main elevator to re-enter the screening section.

The re-ground jig-middling that passed 10-mesh, the middling from the roughing and finishing tables, and drainage from the concentrate bins are elevated to a 6-spigot hydraulic classifier having compartments of equal width, but progressively increasing length and depth. This classifier prepares the feed for five Wilfley tables, each of the first five spigots feeding a table. A sixth table is to be erected immediately to treat the sixth-spigot or slime material, part of which is now drawn off in spigot No. 5, and part of which goes off with the overflow to the creek.

All of these Wilfleys make similar products: finished lead concentrate, finished zinc concentrate, finished tailing, and a middling composed largely of poorly sorted grains, which is returned to the classifier.

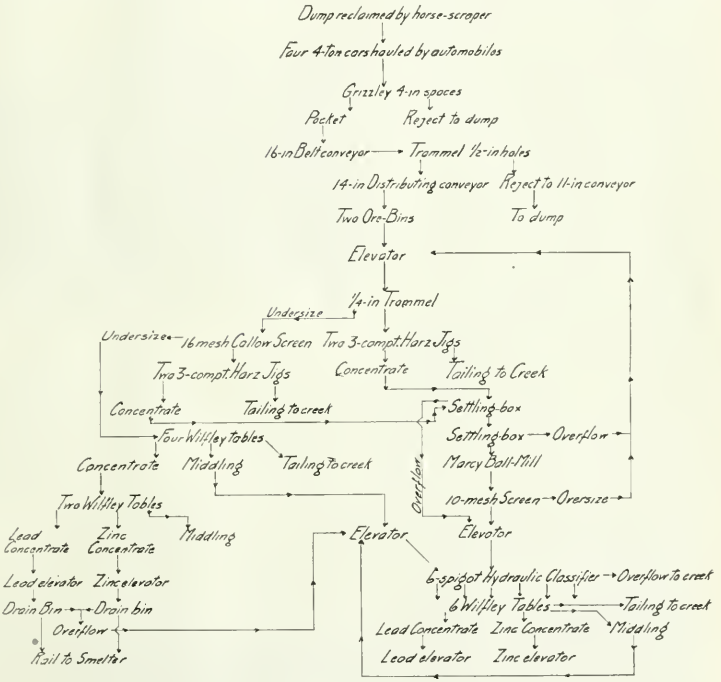
The process of treatment thus consists of a preliminary removal of dry waste on grizzly and trommel, and sizing for three products that receive a roughing treatment on jigs and tables, the bulk of the tailing being rejected as soon as possible. Only the fine concentrate is at once cleaned. The coarse low-grade concentrate is re-ground and with the fine from the preliminary screening is classified with hydraulic water, for the final table-separation.

EQUIPMENT. Some of the equipment has been brought to this mill from other plants and some is new. The old equipment, with the sole exception of the jigs, is giving satisfaction.

The Wilfley tables used for roughing are three of No. 5 type and one No. 6. The No. 6 and one No. 5 have the usual riffling. The other two have an improved riffling. On one the four lower riffles extend to the end of the table parallel with its motion. The remaining riffles are given an upward slope toward the feed side of two inches in nine inches, to a diagonal termination, the upper riffle being four feet long. Every alternate sloping riffle is brought out 22 inches, parallel with the feed side, to a second diagonal termination.

The other roughing-table has a similar riffle except that the end portions parallel with the feed side are brought out the full length of the table. This is the regular No. 10 riffling. These improvements have resulted in a greatly increased capacity.

Among the remaining tables all three types of riffling are represented. In addition a fourth type, known as the Thompson riffle, is used. This is the same as the standard



FLOW-SHEET OF BIG FOUR OPERATIONS.

riffle, except that every alternate riffle is cut off a few inches, forming two parallel diagonal terminations. It is evident that the No. 10 riffle is well suited to the production of clean tailing and a large amount of low-grade concentrate, whereas the Thompson riffle will give a cleaner concentrate than the usual riffle, and take care of losses of mineral by returning a small middling.

Wash and cleaning water are applied to the tables through the usual box fed by separate pipes connected to an overhead line. The finishing Wilfleys are both No. 5; the Wilfleys treating re-ground jig-middling are three No. 6 and two No. 5.

The Marcy ball-mill is of the size known as No. 43. It is 4 ft. in diameter and 26 in. long. It is driven at 32 r.p.m. The lining is of the Krupp type. Crushing is done by steel balls varying in diameter from 1 to 3 inches. Feeding is by scoop-feeder. The discharge is

through a grid of the same diameter as the mill. On the jig-middling the capacity has not been definitely determined, but with proper jigging it is expected that it will handle all provided the fine material is by-passed and the portion of middling formed by any clean particles of quartz that should go into the jig-tailing is kept out of the mill. It does not finish all the product to the desired size, however, and a 10-mesh screen has been attached to the discharge end to return the oversize to the preliminary screening section.

Five elevators are used. The main elevator has a lift of 30 ft. It receives the ore from the bin and oversize from the ball-mill. Re-ground middling is lifted 20 ft. to the classifier by a second elevator. All table-middling and drainage from the concentrate-bin goes to a third elevator having a 30-ft. lift to the classifier. Both the concentrate-elevators have a lift of 30 feet.

Power and Labor. The mill is driven electrically. Current is taken at 54,000 volts from the lines of the Utah Power & Light Co., and is transformed at a substation at the mill to 11,000 volts. It is then reduced to 440 volts in smaller transformers. Only two motors are used, both 3-phase 60-cycle. One, of the Westinghouse make, drives all the machinery of the mill proper. It delivers 40 hp. at 1160 r.p.m.

Power is distributed through five line-shafts. No. 1 shaft drives the ball-mill through a belt, counter-shaft, and gears. It also drives No. 2 shaft, which drives the four roughing Wilfleys and No. 3 shaft. No. 3 shaft drives 4 jigs, the main elevator, and the jig-trommel through two counters and a bevel-gear. It also drives the counter-shaft of the Callow screen. No. 4 line-shaft takes power from No. 2, and drives the remaining four elevators, five Wilfleys, and a counter-shaft from which the concentrate-finishing Wilfleys are driven.

The other motor, a 15-hp. Allis-Chalmers, running at 1150 r.p.m., drives a line-shaft, from which the incline-conveyor is driven by gears, the reject-conveyor by belt, and the waste-trommel by belt, counter-shaft, and gears. This last counter also drives the distributing conveyor.

Thus there are two power-units, one driving the equipment for loading the ore into the mill-bin, the other driving the mill. On the latter drive there is, of necessity, much line-shafting, belting, many loose and tight pulleys, and troublesome clutches. Most of the transmission is well out of the way, allowing good lighting of the mill. It is worthy of note that all dangerous places, near which mill-men must pass on their duties, are protected by railings to promote safety.

Water is taken from a sump in the creek by a triplex pump having a capacity of 300 gal. per minute, and is lifted to the supply-tank at the top of the mill.

While the mill is being tuned up, 5 men are employed per shift. When running smoothly, it will require a jig-man and a table-man per shift, and a conveyor-man on one 9-hour shift.

Results. Concentrate from the tables drops into launders through which it flows to the boots of two elevators, one for lead concentrate and one for zinc concentrate. Each elevator discharges to one of a pair of bins, each 5 ft. 8 in. by 9 ft. 4 in. by 7 ft. 2 in., provided with filters of screen and burlap. During filling the bin drains, and concentrate is allowed to stand in it until the other bin is nearly full. Then the first bin is emptied through bottom gates to tram-cars, by which the concentrate is taken to railroad-cars on a spur of the Union Pacific railway beside the mill. Tests have indicated that the assay of concentrate will be as follows:

	Zinc Concentrate	Lead Concentrate
Zinc, %	39	..
Lead, "	4.4	14
Iron, "	7.8	39
Lime, "	2.7	..
Silica,"	8.6	4
Silver, oz. per ton	7.04	11
Gold, " " "	0.02	0.07

The mill was started on July 20, on one shift. A second shift was added on August 2, and a third on August 3. At the time of my visit, on August 13, it had not got into its stride; shut-downs were frequent for necessary tightening of belts and bolts, alignment of shafting and pulleys, and, in short, the treatment of the usual ailments of a new mill. Actual results of operation, therefore, are not available, but an estimate of recovery based on tests conducted by the designers of the mill, checked by past experience on similar material, is as follows: 40% of the lead, zinc, and silver, with 25% of the gold. By the addition of flotation treatment, the recovery of zinc could be raised to nearly 70%. Flotation is not to be added for the present.

It is planned to increase the capacity of the plant by the addition of four Wilfley tables and another trommel. When operating at 200 tons per day there should be produced daily 10 tons of lead concentrate and 8½ tons of zinc concentrate.

It is also planned to use a drag-line excavator for piling the tailing near the track.

No cost data are as yet available, but it would appear that the cost of reclaiming the tailing and putting it through the mill should be low, with promise of a fair profit from the operation.

The mill was designed by Kirk & Leavell of Salt Lake City, and is operated under the supervision of M. P. Kirk, with Jack Sweat acting as foreman. To these men is due an acknowledgment of generous aid in obtaining data for this article, in the midst of the unsettled conditions attendant upon 'tuning up' a new plant.

Awaruite, a variety of nickel-iron, consisting of 67.93% Ni, 0.70 Co, and 31.02 Fe, has been detected as a primary constituent in peridotite on the west coast of New Zealand. In the river-beds of Josephine and Jackson counties, Oregon, boulders of a nickeliferous iron up to 100 lb. in weight have been found. This has a composition very nearly Fe_2N_5, while awaruite is Ni_2Fe. The large blocks of nickeliferous iron of Uvifak, on the island of Disko, Greenland, weighing 25 tons, occur on a basalt sheet. Masses of iron, said by the Chinese to be three miles long, are reported from the Province of Szechuan, China.

Tramming Sand-Tailing

By JESSE SIMMONS

Disposal of sand-tailing is always a problem presenting more or less serious aspects, especially when conditions are such that sluicing is prohibited. At the Wasp No. 2 mill, at Flatiron, South Dakota, sluicing is precluded. A railway-track skirts the foot of the hill on which the plant is situated, and Whitewood creek, paralleling the railway, must not be polluted.

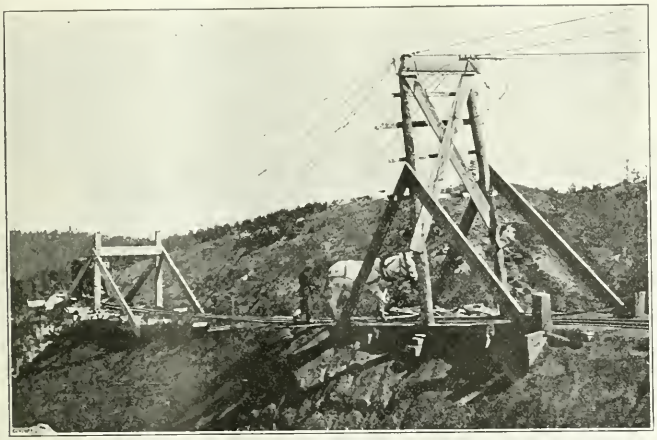


Fig. 1.

Tramming of the tailing has been the means of disposal always followed except for a short trial of belt-conveyors. These were highly unsatisfactory, especially in winter, when the damp tailing froze to them. Tramming, too, was unsatisfactory, chiefly owing to the tracks settling each night; this was particularly pronounced during the rainy season, and in the spring when the frost was leaving the dump. On such occasions the tracks would often settle three or four feet during a day, and it was necessary to use great quantities of timber. Eventually it became apparent, as the dump was extended, that the cost of timber would become prohibitive, so other means of supporting the tracks were sought.

The present plan, which works to perfection, is to support the tracks by means of wire ropes, one end of which is fastened to 'dead men' in the ground near the mill. They are passed over towers and attached to the framework on which the track is built. Fig. 2 shows the three tracks, supported in this manner. It will be noted that beyond the towers the tracks are in the air. The dump contains over a million tons of tailing, and it is constantly settling. After a heavy rain the settling is particularly noticeable; tracks that a few hours previous were apparently resting on the tailing, will be several feet above it.

It will be noted that the gradient of the track is upward, after passing the towers. From the loading-point, under the leaching-tank, it is downhill to the towers. A loaded car runs to the end of the track by the momentum it gathers in coming down the grade to the tower; it then returns to the tower, where the mule is hitched on, and the return trip to the loading point is made. The entire operation is smoothly and quickly done. The cars hold 2500 lb. of tailing; they are of the side-dump pattern, and discharge their contents quickly upon throwing a lever. One trammer rides the car to the end of the dump; his duty is to unload the car. Fig. 1 shows the car about to be dumped, and the mule being put in position to be hitched to the car upon its return to the tower. In Fig. 2 may be seen a few odds and ends of timber sticking out of the dump; it was formerly used by the trainload.

Each leaching-tank in the mill is provided with two bottom-discharge gates; each of the three tracks serves two tanks. The dump-car is filled by shoveling, or scooping with shovels, the tailing through the discharge-hole into the car standing immediately below. Edward Manion, the superintendent, who devised and installed the system, states that by its use the cost of tailing disposal has been reduced to 4½ cents per ton. As the gross value of the Wasp No. 2 ore is only about $1.80 per ton the saving is 2½ per cent.

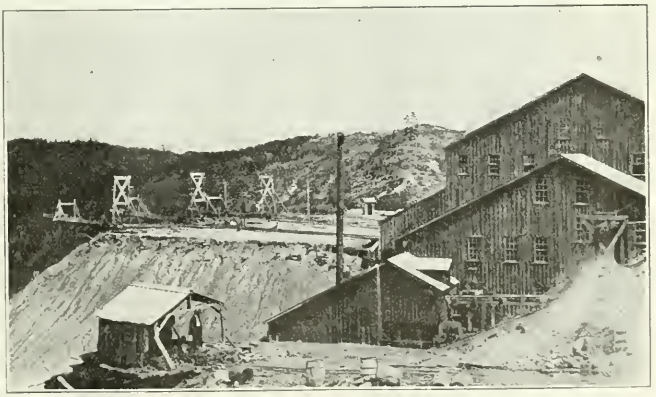


Fig. 2.

The Application of Efficiency Principles

By FRED H. RINDGE, Jr.

The skill with which 'Efficiency' is applied—what shall determine it? Does any system absolutely insure efficiency? Can an 'engineer' make men efficient? Are there other factors not generally recognized in the usual 'efficiency plan'?

In a booklet called 'The Profit Sharing Plan of the Ford Motor Company' I have just read "Man is largely a creature of environment. His interest in his work, his efficiency at his work, his loyalty toward his employer depend largely upon his surroundings during working hours. Light, ventilation, sanitation—all factors of health and efficiency—are given prime consideration. The approximately 15,000 workers at the Highland Park factory are taught to be clean and healthy—and so efficient." Surely these things are factors, but are they the only factors? Evidently the Ford company does not think so, for one of the instruction sheets issued to the special investigators reads: "We must know through you positively as to the conduct of employees outside of business, the extent of their indulgences that make for good or bad manhood.* * * The home conditions particularly, are of vital importance." Illustrations from other companies might be given.

Can it be true that such things as home conditions and the conduct of employees outside business have any relation to efficiency? And that phrase "good or bad manhood," what has that to do with efficiency? Has it a character basis? Is Big Business becoming concerned about these things that not many years ago would have been considered none of the employer's affairs? There may be some question as to just how far a company is justified in prying into such matters—it depends, I suppose, on how the investigator behaves himself. But there can be no question about the successful employer being vitally interested, for these things are all factors of efficiency. Anything that can magnify their importance and that especially can improve the character of employees will tend to increase their usefulness.

But this is only one side of the question. How about the man higher up—the foreman, superintendent, engineer, manager, president? He is the man who, other factors permitting, will determine the success with which 'efficiency' is applied. How can he best determine it? Shall he drive men or lead them; shall he get all he can or give all he can; shall he apply scientific management principles regardless of the men or because of the men; shall he use 'efficiency' for his own interest or for that of his employees as well; shall he use motion study, time study, and business organization to grind men down or to lift men up? In short, shall he be a man of self-interest or a man of social interest and a man of character? Can it be true that anything which improves the character of employees will tend to increase their efficiency also, and through them the results of the system as a whole?

From a purely business standpoint it looks as though the factors conducing to efficiency are numerous and complex, that they are determined by both employer and employee, and that they can be resolved into a character basis. It may be objected that many men are effective in business yet lacking in character, but the keen efficiency expert would question whether those men are as effective as they could be, and ought to be. Would they not be much more useful if they were men of character, and will they and their business 'win' in the long run? Business is increasingly a "survival of the fittest," but who in the long run is the fittest?

Many of these ideas are splendidly brought out in a paper read at the last annual meeting of the American Society of Mechanical Engineers:

"The development and application of the highest types of industrial management, is going to be difficult and delicate work, if the results are to be made a permanent benefit to society as a whole. Those who personally direct this development will largely determine the efficiency with which efficiency itself is applied. If the attempt is made by those in charge to seize all the benefit of improved methods and to crowd the advantage of the employer they will either defeat or indefinitely postpone the advance. They must be experienced men, wise, fair, thoroughly conversant with possibilities and free from sentimental idealism. This means not only a knowledge of machinery, systems, and time study, but of human nature and the rights and real needs of industrial workers.

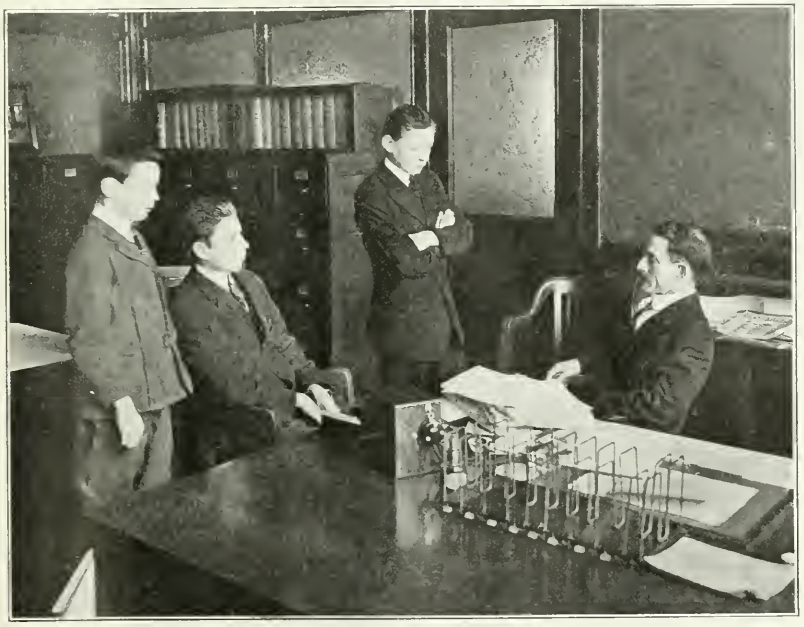
"The executive engineer will be at the focus of this situation. He alone is in direct personal contact with the two great elements involved; capital and labor. His thorough understanding of both of these forces will prove one of the greatest elements in progress. If the man in actual charge has little knowledge of, or sympathy with, the workman, serious missteps are certain. If, on the other hand, to a thorough technical training and knowledge of the resources and responsibilities of the employer, he adds an attitude of fairness and friendliness, and a personal understanding of the workman involved, the new force will work out to the good of all concerned. Scientific management offers an opportunity to pay better wages, but it will require strength and wisdom to apportion the economic gain fairly, and to maintain a just distribution of it."

Who can deny the truth of this argument? Lately I have been studying the problem of the human side of management and have been impressed by such state-

ments as these, by men who know: "Motion study is not a cure-all for any sort of industrial ill. A surgeon's knife can be used with killing effect in the hands of a novice. In the hands of a skilled surgeon it can be made to serve as a means of curing serious physical ailments. So with motion study. Its proper and judicious use by persons who are familiar with its application, can effect many and great economies in almost any industry." Notice the emphasis placed on the man. F. G. Coburn, Assistant Naval Constructor in the U. S. Navy, has been quoted as saying: "The system of management is but the tool of the manager. Alone it is useless, may even be dangerous — * * * labor-saving management is a system that forces the executive to manage."

How shall he manage? Shall he be fair, considerate, humane, or the reverse? Shall he delegate all dealings with the men to his subordinates, or shall he himself keep in personal touch with them? Years ago the executive was 'the old man' and personal touch was not only easy but necessary. Conditions have changed, but this does not mean that the personal touch must therefore be eliminated. The personal touch and right dealings make for efficiency, which in turn, depends largely upon the man above.

Thus, to return to our starting point, it seems clear that there are other important factors besides a system and an engineer. Among the most important of these other factors are right working, living, and recreative conditions surrounding employees, loyalty, goodwill, and the good character of the men. These conditions are brought about and these qualities are engendered in men through the influence of the man or men 'above.' How important therefore that these men themselves shall be of the right kind! Charles W. Eliot expressed the idea superbly in one of his addresses: "Without the sentiment of loyalty, happiness in labor is impossible; with it the humblest service yields solid and lasting satisfaction. * * * It is an unhappy condition of things when political liberties get disassociated from personal liberties, through change of character in the object of loyalty, or through the disillusionment of the loyal. Just industrial liberties and satisfaction in work cannot be surely won, or safely kept, without worthy loyalities. The industrial democracy needs to improve its aims and ideals as well as to get more pay, more leisure, and healthier conditions of labor; and its greatest need is a state of mind capable of unselfish loyalty." I am purposely quoting more than usual because the opinions of both the practical business man and the sociologist are worth everything.



OFFICE-BOYS GETTING ADVICE.

Every company is concerned about the securing of the right kind of employees (men of character and goodwill) and the right kind of engineers, managers, efficiency experts, etc. (men of character and ability to engender goodwill). How can such men be secured, how can they be held, and how can those already employed be transformed into the right kind of men? This is the vital question. It is both social and individual. Many organizations are working to better social conditions (the working man's environment) and to better the man

himself. Among these agencies an important one is the Young Men's Christian Association, because of its extensive service to industrial men and boys. During the past year this Association alone had in its North American membership 100,000 industrial workers, while 400,000 more were helped in extension features, educational, recreative, and character-building. Half a million men were served by the Railroad Associations, and 310,000 foreigners were definitely helped toward a knowledge of English and other things that make them desirable American citizens. All such work helps to solve the problem of man—efficiency. The work for foreigners alone affords a splendid illustration. The Association starts its service at 15 ports of embarkation in Europe, helps the men in the steerage, meets them at Ellis Island and other ports of entry, and is alert to secure employment, teach English and civics, and acquaint them with the new life at their final destination. Writing in *Factory* in February, M. C. Albright mentions a practical application of this work: "To induce in the worker the right attitude toward safety is a task that demands not only considerable tact and persistence on the part of the management, but nicety of judgement to a marked degree. * * * Various plans have been evolved to accomplish this result. The greater the proportion of low-grade and non-English-speaking help, the more elaborate must be the plans. One plan being applied with considerable success through the co-operation of the Y. M. C. A. is to combine the teaching of safety with English. Words are used which apply to operations in which the men are daily engaged." Many companies are bringing about a similar increase of labor-efficiency through well-known educational and welfare methods. Some feel keenly that it is desirable to have such work promoted by some neutral agency like the Y. M. C. A., because this removes all possibility of paternalism and misunderstanding on the part of the men.

Much also is being done by employers and others to increase the efficiency of the man above. We have noted the importance of the engineer and others in influential industrial positions being men of sympathy, tact, judgment, and ability to handle men. It is therefore especially interesting to observe the increasing care with which such men are being selected on the very basis of these human qualifications. Some of these are men of practical experience chosen from the ranks, many others come from colleges and engineering schools. Naturally, therefore, we are concerned about what the colleges are doing to equip coming industrial leaders not only with the technical but also with the human qualifications of their profession. Many colleges have, in the past, been exceedingly negligent in this respect. Business men have become disgusted with the 'product' of certain engineering schools. A general manager said to me recently, "We have in our shop graduates of about 20 different colleges and technical schools. Those fellows are a damned nuisance!" When I pressed him for an explanation he said, "They are all right on the theory, but when they begin to deal with working-men they sure do make a mess of it. They haven't got the workingman's point of view and they don't deal with him right!"

With so important a problem before us it is significant to note the growing desire of college professors to meet this need. An increasing number of engineering schools are offering courses in industrial management, and in many of these courses the human side is given a considerable place. I have before me the Pennsylvania State College syllabus announcing a complete course in industrial engineering, which includes a study of principles ("The field and methods of the science of management and the fundamental considerations as to men, materials, machines, methods, and organization which enter into the work of the efficiency engineer"), organization (including "general and departmental organization, power, light, heat, ventilation, sanitation, and transportation arrangements. Cost, time-study, labor-efficiency, wage-systems, safety and welfare methods"), management, factory planning, etc. The University of Wisconsin, Cornell University, and a number of other colleges have splendid courses along these lines, which especially bring to the fore the human side of the engineering profession. Last year Yale gave the senior engineers a special series of eight lectures, which would make them consider their human responsibilities after graduation. All these are steps in the right direction.

The Industrial Service Movement, which started at Yale seven years ago and has spread all over the country under the auspices of the Young Men's Christian Association, is helping in many ways to solve the problem. It is promoting lectures on human engineering and groups of discussion for interested students. It cooperates with the faculty in providing special class-room speakers who are specialists along these lines. It brings back to the college prominent graduates who have been notably successful in dealing with men, that the coming generation may learn something of how they do it. It has prepared special literature to convince students of the reality of the very things that I have been discussing. Most important of all, it enlists students in practical service for working-men and boys. This service may involve teaching foreigners English, instructing American workmen in technical subjects, or a hundred other things. Whatever the service is, care is taken that the college-man and working-man get together in a friendly way, which makes for mutual understanding and respect for each other's point of view. The student himself learns many things. He also comes to appreciate the other fellow and learns how to deal with the workman successfully. Scores of college-men all over the country have personally told me that such work has helped them in ways too numerous to describe. The surprising part of it is that, without interfering in any way with their studies, 3500 engineering students from 200 colleges are now finding time to do this work without any financial compensation. But who can doubt that they will be fully compensated by their future success as leaders of men? Surely industry may in the future safely count

on such men to promote goodwill, loyalty, and character, through fraternity and the personal touch. Many such a man has had his own character improved as a result of his service experiences while at college. Is it too much to expect, as the colleges train more men of this type, that the problem of management already indicated may in large measure be solved? Will not these very men help to determine aright the spirit with which 'efficiency' is applied?

J. Parke Channing, vice-president of the Miami Copper Co., read a paper on this Industrial Service Movement at the last annual meeting of the American Institute of Mining Engineers. The following quotation is a real contribution to our discussion:

"It may seem surprising that 3500 engineering students, each carrying a heavy course of study and with many other interests, can find an evening or two each week to engage in some form of definite service, without any financial compensation. But such is the case, and on the whole a careful survey of their work reveals efficiency and permanency in a high degree. If industrial men are at first suspicious, their suspicion soon wears away in the face of frankness and friendliness. If the employers have any doubts they do not last long. (If they will visit any of 200 points they will find students teaching foreigners in railroad box-cars, stores, clubs, halls, pool-rooms, restaurants, and boarding-houses as well as in the more dignified meeting-places—schools, churches, settlement-houses, and factories. They would see American working-men instructed in mines, shops, and labor-unions. They would look with interest upon recreative games, talks, first-aid, and safety promotion in all sorts of places at noon, afternoon, evening, and midnight. And we have seen 500 men crowded around the machinery of a huge plant listening to a straight noon-hour talk on clean living, character building, and vital religion). We have looked with amazement on 50 factory boys following enthusiastically a college football captain who took enough interest in them to organize a boys' club or a factory athletic league. It has all been done in the finest kind of spirit, without patronage, with modesty and with efficiency, and during the past year those 3500 student leaders reached over 60,000 working-men and boys in a very personal and directly helpful way. The secretary of this movement has talked with hundreds of employers and college professors throughout the country, and all seem enthusiastic over what has been accomplished. Fine! but what has this to do with engineering? Just this—that every one of these 3500 students would be willing to say that he has gained far more than he has given. Furthermore, a study of the situation proves that he has gained in large measure the very qualities he needs—an appreciation of working-men, adaptability, leadership, a knowledge of how to deal with men in a way to get results and to avoid harmful labor difficulties."

A TALK IN THE FACTORY.

In all this work the students are learning much more than the possibilities and limitations of welfare work. They are acquiring a personal attitude toward fellow-workmen that starts out right. If the engineer starts

out right in this way he will probably stay 'right' during the rest of his career, for goodwill is a highly-multiplying power. The number of engineering graduates who have the right attitude and method can be greatly multiplied by a wider promotion of the plan indicated. Suppose the 200,000 college-men of the country could go out into the larger world with this spirit and purpose? As it is now, recent graduates spend most of their time, thought, and skill on problems of output, and grades, tonnage, and trade. Their sensory nerves respond quickly to the suggestion of dividends and their motor nerves to making a record. In ten, perhaps five, years many of these men will be centres of power in the industries to which they have gone, and will have influence enough to determine in large measure the policies of the company they serve. Many of these men will become efficiency engineers. At their word, machinery will be torn out and new inventions installed, new methods adopted and new paces set for progress. Will these young engineers become just as influential in developing progress in the 'humanics' of industry? Why not? The plan described certainly helps to solve the problem. If the interested manufacturers of the country would, from their own experience, urge the colleges to give more attention to the human side it would help greatly to solve these problems.

These are days of great industrial and social problems in America. They are also days of good deeds. Industry is increasingly assuming its burdens. The leaders of industry are accepting greater responsibility for improving conditions. They are making possible better relationships between capital and labor. Many changes are being wisely wrought, and the watchword is 'efficiency.' Both employers and employees are becoming more anxious to attain it to a higher degree. The efficiency of those who are managed and those who manage is a more vital factor in real success than ever before. Scientific management in the best sense has a great future, and this future will be determined by the skill with which efficiency is applied.

Agricola, writing about 1550, seems to have known something of the bad side of mining, for he says: "The following are some of the wicked and sinful methods by which they say men obtain riches from mining. When a prospect of obtaining metals shows itself in a mine, either the ruler or magistrate drives out the rightful owners of the mine from possession, or a shrewd and cunning neighbor perhaps brings a lawsuit against the old possessors in order to rob them of some part of their property. Or the mine superintendent imposes on the owners such a heavy contribution on the shares, that if they cannot pay, or will not, they lose their rights of possession; while the superintendent, contrary to all that is right, seizes upon all that they have lost. Or, finally, the mine foreman may conceal the vein by plastering over with clay that part where the metal abounds, or by covering it with earth, stones, stakes, or poles, in the hope that after several years the proprietors, thinking the mine exhausted, will abandon it, and the foreman can then excavate the remainder of the ore and keep it for himself. They even state that the scum of the miners exists wholly by fraud, deceit, and lying. For to speak of nothing else, but only of those deceits which are practised in buying and selling, it is said that they either advertise the veins with false and imaginary praises, so that they can sell the shares in the mine at one-half more than they are worth, or on the contrary, they sometimes detract from the estimate of them so that they can buy shares for a small price."

Flameless combustion results when a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion (or with air in slight excess), is caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into radiant form. The advantages claimed for the new system are: (1) The combustion is greatly accelerated by the incandescent surface, and may be concentrated just where the heat is required; (2) the combustion is perfect with a minimum excess of air; (3) the attainment of very high temperature is possible without the aid of elaborate regenerative devices; and (4) by reason of the large amount of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is rapid. These advantages are so uniquely combined in the new system that the resultant heating-effect is, for many important purposes, not only pre-eminently economical but also easy of control. It is obvious that this process is adaptable to many furnace operations, as, for example, the heating of retorts, annealing-furnaces, and the like. It is not essential that the bed of refractory material shall be disposed around the vessel or chamber to be heated; it may be equally well packed into tubes, or the like, traversing the substance to be heated. This latter modification is important in relation to the melting of metals or alloys which are fusible at temperatures below about 600°C., and also in relation to steam-raising in multitubular boilers. By this process, much higher temperatures are attainable with a given gas than by the ordinary methods of flame combustion without a regenerative system. In a crucible fired by coal-gas on this system a temperature of 1880°C. is easily reached. Platinum also melts readily. Using air preheated to 500°C. with coal gas, a temperature estimated at somewhat over 2000°C. has been attained. A very resistant chromite, not melting at 1880° C., was fused in this way. Crucibles of alundum are fused without preheating the air. A 110-tube boiler capable of evaporating not less than 5500 lb. of water per hour showed great economy when fired with coke-oven gas on this system. Tanks holding 8 tons or more of molten lead heated by flameless combustion have been proved to utilize about 70% of the calorific energy of the fuel employed.

Gold output of the Rand in August was 778,763 oz., the largest yield since May 1913, when it was 794,306 ounces.

A Rule Governing Cupellation Losses

By W. J. SHARWOOD

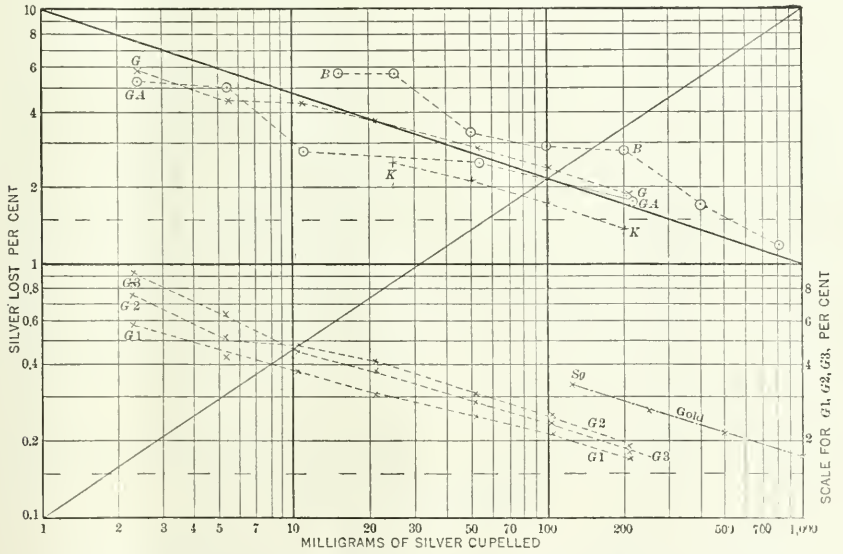
*Cupellation is well known to be one of the most effective methods of separating gold and silver from the base metals and other impurities, as well as one of the most accurate means for their estimation. In the latter application it consists in absorbing in some porous medium the fused lead oxide formed by the oxidation of the lead 'bath,' which carries with it the oxides of other base metals present.

It has long been recognized that small amounts of both silver and gold were removed and absorbed together with the base metals, as well as being to some slight extent volatilized, and in work of the highest accuracy a correction is made for the 'cupellation loss.'

Thus in the assay of bullion this is done by means of 'proofs' of like composition, which are manipulated throughout in precisely the same manner as the assay-pieces, and are assumed to lose or gain like amounts. In the case of certain very rich ores and commercial products the loss is adjusted by assaying the cupel itself and recovering the precious metal absorbed, but this doubles the labor and does not remedy the loss by volatilization. Arbitrary tables have been drawn up by various authorities with the object of enabling a correction to be applied without the use of a check. These have been of limited practical use owing to the fact that a number of factors affect the losses sustained.

For a fixed amount of precious metal the loss varies with the amount of lead used, with the nature and amount of impurities, with the porosity of the cupel, with the air supply, and above all with the temperature at which cupellation is carried on. Pure silver loses relatively much more than gold, but the loss in either is diminished by an addition of the other metal. The concentration of precious metal in the litharge increases as the concentration in the lead increases, but little work has been published connecting the two. If all conditions remain the same the actual total loss increases, but the percentage loss diminishes, with an increase in the weight of precious metal treated.

The results of an immense number of experiments have been published at various times during the past hundred years giving the actual or the percentage-losses suffered under various conditions of cupellation, but the data are widely scattered and few attempts have been made to correlate them, so that no definite law has heretofore been shown to exist governing the relation of



G = Godshall, average of three series. K = Kauffman.
GA = Godshall, average of Tables A and B. B = Beringer.
G1, G2, G3, = First, second, and third rows in muffle of Series G. Sg = Sharwood (gold).

FIG. 1.—The percentage losses, alone are given, this being the form used in most publications. Godshall's results for various muffle rows are placed for clearness in the lower portion of the diagram.

*A paper to be read at the September, 1915, meeting, at San Francisco, of the American Institute of Mining Engineers.

weight and loss, although Fulton has published curves covering certain conditions. If such a law were known it would enable a correction to be applied to a button of any weight, by a calculation applied to the loss in a proof of an entirely different weight, but cupelled at the same time under the same conditions. It is believed that such a rule is now available.

This empiric rule may be thus enunciated: When a given amount of silver (or of gold) is cupelled with a given amount of lead, under a fixed set of conditions as to temperature, etc., the apparent loss of weight sustained by the precious metal is directly proportional to the surface of the button of fine metal remaining.

Probably the calculation should be based on the original weight of precious metal taken, but in practice we have to depend on the weight remaining. Variations in the amount of lead have comparatively little influence, and temperature conditions in a given row across a muffle are nearly uniform, so that for practical purposes the ratio holds good for any one row in a cupellation run, provided the amounts of lead do not differ extremely. Most other variations have smaller effects. If the above is true the following must also be true.

The loss of weight varies as the $\frac{2}{3}$ power of the weight, or as the square of the diameter of the button.

The percentage loss varies inversely as the diameter of the button, or inversely as the cube-root of the weight.

Examination of a large number of experimental results, as well as the published data of others, proves that the last proposition is a close approximation to the truth, and therefore proves the others. The readiest proof of the rule, which avoids all calculation, is by the aid of logarithmic paper—that is, paper on which the ordinates are plotted on a scale like that of a slide-rule.[1] In place of using the ruled paper the distances may be actually laid off by means of a slide-rule scale. When plotted in this way the graph of any equation of the character $y = Cx^n$ appears as a straight line, and all straight lines for a given value of the power n are parallel. If the horizontal and vertical scales are equal (as in Fig. 1 and 2) the tangent made by the line with the x axis is the exponent n.

If therefore we plot on the x axis the weights of a series of silver buttons cupelled under precisely similar conditions, and the corresponding losses on the y axis, and the corresponding points fall approximately on a straight line, then we know that y varies as some power

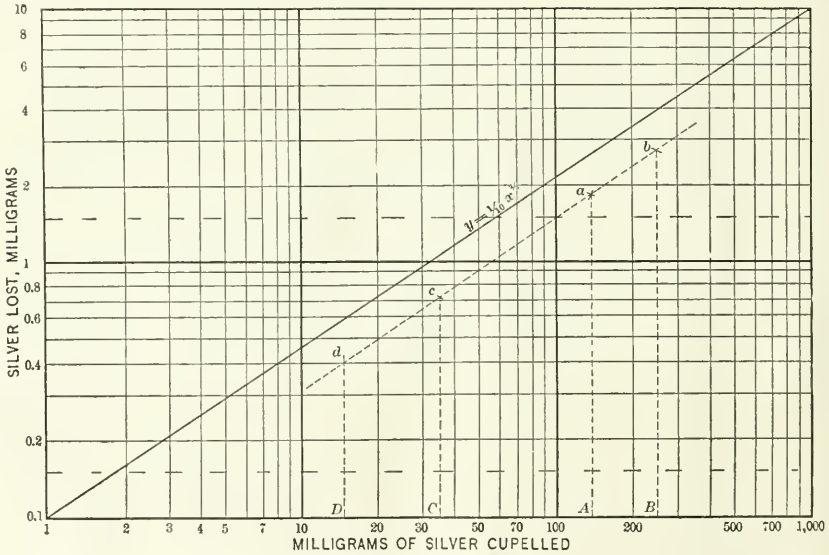


Fig. 2.

of x. Drawing a line parallel to the general run of these points from the point $y = 1$, $x = 1$ to $x = 10$ or 100, will indicate at once what the value of n actually is.

If any one will take the trouble to average and plot a series of cupel losses on buttons of various sizes carefully cupelled in the same row, he will, I think, find that they will fall nearly on[2] lines parallel to

$$y_1 \text{ (weight lost)} = x^{2/3}$$

and

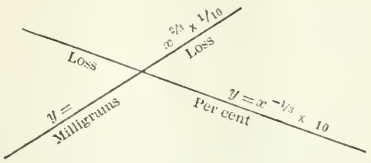
$$y_2 \text{ (percentage lost)} = x^{-1/3}$$

The distance between the parallel lines obtained in various series simply corresponds to the values of the con-

[1] Multiple logarithmic paper may be obtained at a very moderate price through the Department of Civil Engineering, University of Wisconsin.

[2] In the case of the smaller weights, say those below 10 mg., a considerable deviation from a straight line will probably be observed, unless a large number are averaged, as the relative error due to a difference of a few hundredths of a milligram then becomes serious.

stant c for different conditions of temperature, muffle-draft, etc.



A few results are shown thus plotted in the accompanying diagram.

I have found that such series as those published by Klasek, Godshall, Beringer, and Kauffman (omitting erratic ones), and a transcription of the curves plotted by Fulton, all give points falling nearly into general parallelism with the lines indicated, and my own values for silver alone and gold alone agree well except for the smaller values, where irregularity naturally occurs. This rule is the dominant factor in cupellation loss, temperature alone excepted.

As to the possible application of this rule: An approximate correction may be obtained for an ore or the like, if one proof, as near the expected weight as possible, is cupelled in each row, and its exact loss noted. The corresponding point is plotted on the diagram (a in Fig. 2, A representing the final weight), and a straightedge is placed on the diagram, or a line drawn through a, parallel to the guide line, $y = x^{2/3}$. Noting the points on the line or straightedge corresponding to the weights B, C, D, of other buttons weighed, the correction for each is read at once from the scale. In the example plotted in Fig. 2 a button of 140 mg. weight has lost 1.8 mg.; from this it appears that other buttons of 250, 35, and 15 mg. will respectively have lost about 2.85, 0.72, and 0.40 milligrams.

KAURI-GUM mining is next in importance to gold mining in New Zealand. It is found over an approximate area of 814,000 acres; over this region it occurs on both the driest fern hills and in the deepest swamps in lumps up to 100 lb. in weight. Transparent or semi-transparent specimens fetch very high prices from collectors. The great bulk of the resin is used in the manufacture of varnishes. The gum diggers use a light pointed iron rod to test the ground, from which the gum is dug out with a spade. Occasionally the diggers strike rich patches. Some Austrians took out $750 from a small ravine in 1913. In this year the product was valued at $2,600,000; the best grade gum sells for $1500 per ton. Single specimens of transparent gum the size of a man's fist have sold for $125. The Mitchelson collection recently presented to the Auckland Museum is valued at $10,000. The total production to the end of 1914 is about $80,000,000.

CINNABAR ore treated in the United States in 1914 totaled 122,988 short tons, yielding an average of 10.1 lb. of quicksilver per ton.

CHAIN-DRIVEN tube-mills at the Tonopah-Belmont mill cost $0.00184 per ton of ore treated for chain repairs.

Zinc-Dust

Summarizing his investigation of zinc-dust precipitation tests, Nathaniel Herz, of Lead, South Dakota, draws the following conclusions:

Zinc-dust, satisfactory for precipitation of precious metals from cyanide solutions, should pass the following tests: It should be fine; that is, most of it should pass through a 200-mesh screen, and the fine portion should be very much finer than the screen opening. As the surface exposed per unit weight varies inversely as the diameter of the particles, and the number of grains varies inversely as the cube of the diameter, if the average diameter of one lot of dust is one-half that of another, the finer would have twice the surface and eight times the number of particles. The dust would remain in suspension better, and, if uniformly distributed, the distance between grains would be half that of the coarser material.

The oxide should be low, but very low oxide does not necessarily indicate a good zinc. There should be a reasonable amount of lead, over 1%; as high as 4% may do no harm. Cadmium is usually present, and some cadmium may take the place of part of the lead. If oil is present, it should not be in such quantity as to prevent good mixing of the dust with the solution. Precipitation with a standard solution of silver cyanide gives a rapid method for approximating the value of a particular lot of zinc-dust. If the efficiency is well over 40% (100% being the theory for complete replacement of pure zinc by silver), the zinc is satisfactory. If under 30%, the dust will probably give poor results.

The condition of the metallic impurities may have considerable influence.—*Bulletin* 104 of the A. I. M. E.

Dredging in California

Compiled by Charles G. Yale, statistician, U. S. Geological Survey.

Year	Number of dredges.	Value of yield.	Increase (+) or decrease (—)
1898	3	$18,887	.....
1899	8	206,302	+ $187,415
1900	16	200,929	— 5,373
1901	22	471,762	+ 270,833
1902	29	867,665	+ 395,903
1903	31	1,475,749	+ 608,084
1904	42	2,187,038	+ 711,289
1905	50	3,276,141	+ 1,089,103
1906	59	5,098,359	+ 1,822,218
1907	57	5,065,437	— 32,922
1908	69	6,536,189	+ 1,470,752
1909	63	7,382,950	+ 846,761
1910	72	7,550,254	+ 167,304
1911	65	7,666,461	+ 116,207
1912	65	7,429,955	— 236,506
1913	63	8,090,294	+ 660,339
1914	60	7,783,394	— 306,900
Total		$71,307,766	

The principal centres are Marysville, Natoma, and Oroville.

Handling Leady Copper Matte

By H. F. EASTER

*The leady copper matte produced at the El Paso Smelting Works during October, 1914, averaged Fe, 42.1; Pb, 12.1; Cu, 19.8; Zn, 4.6; S, 21.4%; Au, 0.04 oz.; Ag, 87.8 oz. The average grade of the bullion produced was: Au, 3.24; Ag, 247.6 oz. The matte produced averaged 8% of the total charge. Lead on the charge averaged 15.7%, and sulphur 2.2%. Coke used averaged 14.2%. These figures, while applying to only a single month, may be taken as fairly representative of the lead-smelting practice of the plant.

The high copper in the leady copper matte, is characteristic of the usual conditions at this plant. It had long been customary to set aside matte of about this grade until a sufficient amount had been accumulated to make worth while a concentration run. The matte produced during these campaigns usually averaged about 10% Pb and 35 to 40% Cu. It was drawn off in hand-pots, cold-dumped, broken by hand, and re-smelted through the copper blast-furnaces. All this involved considerable expense and it became evident that much of this could be saved if some means were provided for getting this molten leady copper matte direct to the converters. The round oil-fired settlers offered a convenient reservoir in which to collect the matte in fairly large quantities, and a pit 10 ft. wide and 8 ft. deep was dug immediately in front of the settlers in order to allow the approach of the 5-ton matte ladles serving the converters. About this same time the rolling-stock equipment of the plant received a much needed addition in the shape of several Treadwell slag-cars of 160 cu. ft. capacity, holding about 14 tons of slag each. These cars superseded the older one of small capacity and made it possible to handle all the slag and matte away from the furnaces over a single straight track laid in the pit in front of the furnaces, entirely doing away with the necessity for hand pots for any purpose. This, however, involved a radical change in the use of the settling-tanks, inasmuch as all the leady copper matte was run over into them and the rectangular box was used only as a collector for lead. Owing to the high proportion of copper on the charge and the large amount of dross produced, the lead-wells of the furnaces are hard to keep open, and most of the time all the lead passes out of the top hole and must be separated outside the furnace.

The direct conversion of the leady copper matte proved to be such an economy that since the introduction of this system, matte has been converted that is much lower in copper than formerly. It is now customary to figure the value of the lead contained in the leady copper matte, and therefore lost in converting, as against the cost of roasting and re-smelting in the lead furnace, taking into consideration the fact that each unit of copper present means the loss of a certain amount of lead even on a concentration run. Each day's production of leady copper matte is thus disposed of according to its assay, either direct to the converters or poured on the ground in beds, to be picked up, crushed, and roasted. As the matte has recently been rather low in lead, most of it has gone direct to the converters even though it may not run higher than 20% copper.

Under this system the whole duty of settling out the matte is put up to the large settler, and the rectangular box is used only to separate out the lead. Considerable anxiety has been felt as to whether it is safe to rely upon a single settler for the separation of the matte. In an endeavor to throw some light upon this question, the shells from the Treadwell pots have frequently been brought back from the dump and sampled with great care. The most complete of these tests covered a period of five full days early in January, 1915, all the shells produced being saved and run through the automatic sampler. The resulting composite sample showed: Au, trace; Ag, 0.64 oz.: metallic lead, 1.46; Cu, 0.30%. The average of the daily 24-hr. samples for the same period showed: Au, trace; Ag, 0.30 oz.; metallic lead, 1.24; Cu, 0.24%. These figures, which are about in line with all the others obtained under similar conditions, would indicate that it is safe to put these shells over the dump.

The comparative success attending the use of these round oil-fired settlers encouraged the installation of a somewhat similar but larger settler intended to serve two furnaces instead of one. The apparent advantages of this were the greater volume of leady copper matte that could be accumulated at one time, the certainty that one such settler would require less fuel oil than two of the earlier type, and some saving in labor.

This new settler is placed about 6 ft. forward of the line of the front crucible-plates of the two furnaces and equidistant from them. It is 10 ft. inside by 20 ft. long, extending close enough to the edge of the train pit to make it easy to tap matte and slag into the cars below without the use of excessively long spouts. The whole structure is supported upon rails running crosswise and providing air spaces beneath the bottom pan. This feature has proved to be of considerable importance inasmuch as there is a constant seepage of lead through the bottom and the open air-spaces arrest its progress downward into the foundation and facilitate its removal. The ends of the settler are slightly curved in order to give a stronger structure. The sides are braced with I-beams set upright and tied across the top with steel rods.

*Excerpt from a paper, 'Lead Smelting at El Paso,' to be presented at the September (San Francisco) meeting of the American Institute of Mining Engineers.

The sides and ends have a lining of 9 in. of magnesite brick. A matte tap is provided on each side close to the front, and there is a single lead tap in the middle at the rear end. This lead tap is used every day, but little lead is obtained, as experience with the Rhodes separators indicated the inadvisability of maintaining a bath of lead in contact with the matte, and every effort is made to keep lead from getting into the large settler in the first place. The roof of the settler is sectional, being composed of a number of rail-bound firebrick arches that can easily be lifted off if necessary. The stack is situated at the rear end immediately between the slag-inlets from the two furnaces and over the lead tap. Two oil-burners were installed, one playing downward through the roof at a point about 6 ft. back from the front, and one playing nearly horizontal through the front wall.

Between each furnace and the large settler is a removable rectangular box, 2 ft. 6 in. wide by 9 ft. 2 in. long, lined with 4½ in. of magnesite brick all around. The furnace is connected with the box and the box with the settler by short water-coil spouts. Each box is set at an angle of about 45° to the furnace, giving the tapper a clear field for his work.

As it is no longer necessary to provide for the use of hand pots under the slag and matte spouts, it has been possible to arrange the elevation of the various parts of the system to much better advantage than in the case of the round settlers. There is a difference of 20 in. between the tap hole of the furnace and the bottom of the slag-outlet from the main settler, which greatly facilitates the handling of the spouts. There is a difference of 10 in. between the bottom of the inlet and the bottom of the slag-outlet, which allows plenty of time for switching and changing slag-cars after the outlet-hole has been closed up. The normal depth of the bath in the settler is 25 in. with the slag-outlet open, and it is customary to maintain about 10 to 12 in. of matte at all times, as this seems to assist materially in keeping the settler in good condition.

Although this settler was designed for operation with two furnaces, it was decided to try it out with only one, in order to see if it might be kept open under such circumstances. At the time of writing it has been in successful operation with one furnace for exactly one month, although the amount of fuel oil necessary to keep it in good condition is somewhat greater than was the case with the former round settlers. The larger settler requires about 7 bbl. of oil per day, whereas the others averaged about 4.5 to 5 bbl. However, with two furnaces running it is probable that less oil would be required. No serious troubles have been encountered up to the present time, and careful sampling both at the furnace and on the dump indicates that the settler is standing up to its work quite well.

A NEW PYROPHORIC ALLOY, for cigarette and gas-lighters, said to be cheaper than the cerium-iron alloys, and not subject to disintegration, is: Mn, 80%; Sb, 10%; and Cr, 10%. The alloy is air-proof, and is said to produce a long streak of flame, instead of a shower of sparks.

Leaching Copper Ores

The new 250-ton leaching-plant at the Nevada-Douglas mine, Lyon county, Nevada, after much delay, was started in August. Sulphide and oxidized ores will be treated separately and by entirely different methods. The copper, iron, and sulphur are made use of as marketable products. In the treatment of 50 tons of sulphide ore, enough sulphuric acid is obtained at a very low cost to treat 200 tons of oxidized ore. A brief outline of the process is as follows:

The sulphide ores are submitted to acid treatment under pressure in a closed receptacle, in which operation the sulphides of copper and iron are converted into the sulphates of the metals and taken into solution. This solution is then decanted and passed through electrolytic cells, or over scrap iron where the copper is removed. The remaining iron-sulphate solution is then carried to an evaporating-tower, where the water is evaporated and the ferrous and ferric crystals are allowed to crystallize out. These iron sulphate crystals are then put into a dryer and submitted to a temperature sufficiently high to drive off all the water of crystallization. The dried sulphates are then roasted in the Wedge muffle-furnaces, sufficient heat being applied to decompose the sulphates. The greater portion of the gases coming off in the form of sulphur tri-oxide is collected in the absorption-towers and made into sulphuric acid. This is used in leaching the oxidized ores. The remaining residue of ferric oxide is then drawn off and prepared for market.

Leaching of the oxidized ore is carried on in Pachuca tanks, where the ore is agitated with air and leached with the sulphuric acid obtained from the preceding sulphate roast. The solution is then decanted, and passed through electrolytic cells, where the copper is taken out, after which the water is evaporated. The sulphate crystals are dried and roasted in the muffle-furnace as described before.

It will be seen that there is no sulphuric acid lost except that which is consumed by the limestone, and that portion of the sulphur which goes to form sulphur di-oxide in the furnaces.

The total cost for mining and treating sulphide ores is $5.18 per ton. As the average of the ore to be treated is a little above 3% copper, the ore will have a gross value of $12 per ton in copper and will sell at a net profit of $6.82, exclusive of the value of the iron and sulphuric acid. The total cost of producing a ton of iron and sulphuric acid by this method should not exceed $2. With sulphuric acid at this price, oxidized ore as low as 1% metal can be treated at a profit.

BELTS properly tightened with belt-clamps fitted with spring-balances properly to register the tension, according to standards established by careful experimenting, will average twice the pulling power and only a fraction of the interruptions of belts tightened according to the usual methods. As a rule belts should be much heavier than the general practice.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Efficiency = equipment × the human factor.

Solar salt is a name given to salt produced by solar evaporation.

Strontium hydroxide is used in the beet-sugar industry. Germany consumes 100,000 tons per year.

Silver in ore at Shafter, Presidio county, Texas, occurs mostly as a chloride. The output since 1882 is over $7,000,000.

A Klondike miner is said to have taken $600,000 out of a claim 86 by 300 ft., but he died in poverty. One of the quickest fortunes was made by two men who cleaned up $65,000 in 27 hours.

A peculiarity of the Porcupine goldfield is the way in which the metal is 'shot' through the schist on either side of the veins. This is so to such an extent that in some of the mines a vein of two inches of quartz is mined to a width of five or six feet.

The system of passing the fine material from rock-crushers direct to tube or other mills, instead of having it crushed by stamps, is growing in favor. Good and economical results are made at the McIntyre mill, Porcupine, Ontario, by this arrangement.

Artificial crystals of gypsum have been made at the University of Turin, Italy. Limestone kept for two years in a solution of $FeSO_4$ was gradually converted into gypsum. Because of the slowness of the process the gypsum crystals were obtained in a large variety of forms.

Poona is a mountain sickness that attacks people at an altitude of 11,000 ft. in the Andes of Argentina. These mountains are quite different to the Sierra Nevadas in North America. A height of 10,000 ft. is trying in the Andes, but in Mexico this elevation is unnoticeable.

Retention of men in a company's employ is desirable, and some inducement should be made to keep them continuously. Twenty manufacturing firms in the East employ an average of 2200 men, but to keep 44,000 regularly employed it was necessary to hire 69,000 men, resulting in large monetary losses.

Bentonite is a kind of clay which has a variety of uses. It is employed to give body and weight to paper, in the preparation of a dressing for inflamed hoofs of horses, as a constituent of antiphlogistine (a proprietary remedial dressing), and as an adulterant of candies and drugs. It has large powers of absorption, taking up about seven times its own volume of water. It absorbs twice as much glycerine as can be absorbed by diatomaceous earth, and for this reason has been suggested as a substitute for that material in the manufacture of dynamite.

Mineral waste is estimated at $1,000,000 a day by the Bureau of Mines. Waste of natural gas is about $250,000; petroleum waste is $150,000 daily; waste of human life is about 2600 per annum, at a minimum valuation of $5000 per life this waste amounts to $13,000,000 annually.

Staurolite is an iron-aluminum silicate found only in Virginia and North Carolina. The reddish-brown and brownish-black crystals occur in well defined single and double crosses. There is some commercial demand for the crosses as curios, which are worn as watch charms or on chains in the manner of a locket or lavaliere.

Agricola's advice to the buyer of mining shares, though written about 1550, is still sensible. He said, "Moreover, a prudent owner, before he buys shares, ought to go to the mine and carefully examine the nature of the vein, for it is very important that he should be on his guard lest fraudulent sellers of shares should deceive him."

Death-payments under the Workmen's Compensation Acts are a maximum of $6000 in Alaska and a minimum of $2500 in Colorado, while California and Nevada pay $5000. The foregoing refers to the mining States. In the agricultural and manufacturing States the average payment is $3000. Colorado stands out as the State that is least generous to the miner.

Well No. 7 of the Mexican Petroleum Co., south of Tampico, was brought in on September 11, 1910. Since then, up to May 1915, it has flowed at the rate of 20,000 bbl. per day, the estimated output being 39,000,000 bbl. This is by far the largest quantity of oil ever economically recovered from one well in any part of the world. The oil averages 19.3°B., or 0.9376 specific gravity.

Wire ropes coming in contact with water, especially where there is an acid or alkaline tendency, should be carefully and regularly lubricated. The lubricant used should not only penetrate to the hemp centre and thoroughly saturate it, but should also properly coat the inside wires, and have sufficient consistency to cling to the rope and not drop off and leave it practically dry after a few days.

Oil and gas have probably been derived from organic matter contained in shale or limestone, which has been distilled under conditions of heat and pressure produced by earth movement, according to C. H. Wegemann, of the U. S. Geological Survey. The oil may have been impelled through the rock pores to its place of accumulation by water under the forces of capillarity and gravity, or it may have migrated through the rocks in the form of gas which afterward condensed into oil.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

GOLDFIELD, NEVADA

Kewanas, Jumbo Extension, Sandstorm-Kendall, Merger, Atlanta, Great Bend, Silver Pick, and Diamondfield Black Butte.

Development in the Kewanas mine, where a promising orebody was opened lately in the shale-contact area, has been slightly retarded by the necessary timbering and installing additional equipment at the winze, through which ore and waste are extracted and trammed to the shaft of the Laguna mine of the Goldfield Consolidated. The drift, at a depth of 840 ft., has followed the ore for a distance of nearly 100 ft., showing an average width of 3 ft. of shipping ore, assaying from $40 to $60 per ton, with a total width in places of 5 to 6 ft. The discovery is generally considered one of importance as the orebody or ore-channel, in the contact-zone, is similar in many respects to that in the Jumbo Extension, at the south, and apparently is the extension, on its rather flat dip, of the rich deposit found in the Laguna mine to a depth of 600 ft. and farther west, in the Red Top mine, nearly to the surface. An ore-pocket is being cut at the top of the winze, on the 700-ft. level of the Laguna, and a skip is being installed. With this work and some necessary timbering completed, more rapid progress will be made; the main drift will be extended along the ore-channel, raises will be driven, following the dip of the shale, and another cross-cut, 40 ft. north of the winze, should reach the vein within the present week. With the present equipment, according to the manager, A. I. D'Arcy, a production of 100 tons of ore per day can be made without difficulty.

The Jumbo Extension mine continues to show many faces of high-grade ore, both in the shale-contact zone and in workings within the shale. The superintendent, J. K. Turner, regards the discovery of ore in the shale as important, below the foot-wall of the great fissure that penetrates the shale, where there is evidence of a considerable degree of fracturing and of accompanying enrichment. Development in the contact-zone, above the rich 524 drift, and apparently near the top of the hill or ridge of shale in this territory, has yielded excellent results, the northeast drift from the top of the new raise showing 5 to 6 ft. of ore that has assayed from $120 to $220 per ton. In the southeastern part of the Velvet claim the new drifts from raise 526-A, above the 1017-ft. level, continue to reveal ore of excellent grade, while drifts on several levels continue to develop ore far to the east and west of the main workings. A cross-cut will be driven on the 1017-ft. level, from a point near the southwestern corner of the Polverde claim to connect with the Velvet shaft, and by the time the latter is completed this cross-cut will afford connection with the workings throughout the mine. Production is maintained at the rate of 80 tons per day, the ore assaying from $40 to $60 per ton, and it is said there will be no difficulty in maintaining an output that will net the company from $55,000 to $60,000 per month. This rate of production will probably be doubled early next year, with the completion of the Velvet shaft.

On the Sandstorm-Kendall, the station at 200-ft. in the winze below the 500-ft. level, has been completed, and a cross-cut has been started to reach and explore the hanging-wall side of the lode, which is fully 70 ft. wide. The winze entered the foot-wall country a short distance, but the cross-cut is already exposing quartz. Prospects are considered to be encouraging, as small deposits of rich ore have been found at a number of points in the big vein on upper levels. It is proposed eventually to sink to the shale-contact.

In the Merger Mines property the east drift at a depth of 1175 ft. is being advanced, having re-entered the contact-zone after progressing for a considerable distance in shale. This drift, extended from the Grizzly Bear shaft of the Goldfield Consolidated, was advanced at the rate of 10 ft. per day for some time, but has lately required timbering.

Development work in the Atlanta mine continues to expose large quantities of medium and low-grade ore, carrying more or less copper. It is pretty well settled that this ore will be treated here at a good profit in the near future. Cross-cuts on the 1750-ft. level have exposed ore over a wide area, and drifts on the 1660 and 1620-ft. levels are also in good ore. The south drift at the latter depth has lately exposed 3 ft. of $40 ore, nearly all gold, and two raises above this level show seams of good ore, some of them giving assays up to $75 gold per ton. The Atlanta is regarded as a low-grade mine, but already has a large tonnage in sight.

On the Great Bend most of the preparatory work has been completed and old workings on the 400-ft. level have been cleared of debris. A large pump has been ordered, and will be installed at 400-ft. Development will then make better progress. In a raise from the 400-ft. level, lessees exposed some rich ore over six years ago, and other lessees have made money working the upper levels.

The Silver Pick Consolidated is obtaining good assays in the west or Phelan vein, now being explored by drifts on the 500-ft. level. A cross-cut is being driven to the east or main lode on the 600-ft. level.

Lessees on the Diamondfield Black Butte property have exposed some ore of shipping grade.

FAIRBANKS, ALASKA

Rhoads-Hall Mine Closed on Account of High Cost of Supplies.—Newsboy Being Examined.—Tolovana, Reliance, American Eagle, Mizpah, and Fairbanks Creek Properties.—Stamps *v.* Huntington Mills.—New Drag-Line Excavator.—Tolovana.—Antimony.

The largest quartz mine in the district, in point of production, the Rhoads-Hall on Bedrock creek, is to be closed temporarily. It has made a large production of gold, probably a total of nearly $1,000,000 in the last five years, which, apart from a few hundred tons crushed during development, has all been produced by the 5-stamp mill. Practically all of the upper levels are depleted, and work will be resumed only when cheaper power is available. By the upper levels is meant the ground above the main adit, and above a sub-level 70 ft. below. Considering the quantity treated, the mine has made a remarkable record, but fuel costs are becoming so heavy, coupled with increased water and poorer ore in the lower levels, that it was deemed best by the management to stop work until either a central power-plant is erected in the district, or the coalfields can be opened by the Government. With the assurance of a Government-owned railroad, and development of the coal areas, we expect to see this property re-opened within a few years.

The Newsboy mine was unwatered at the end of August to

permit of an examination by men contemplating further development. This property has been idle for over a year, the orebodies developed by the limited amount of work having been exhausted. Competent engineers consider the mine to be worth further exploration. Probably $150,000 has been won from the upper levels, the orebody being 17 ft. wide at 15-ft. depth.

Another promising property which is likely to be resuscitated in the near future is the Tolovana quartz mine on Willow creek. As the present management has not seen fit to even lease the property, it will probably hasten its development to have the mortgage foreclosed and the property change hands.

The Reliance mine has recently been sold to satisfy a labor lien. Whatever disposition of the property is made, it is likely to be re-opened in a short time. $80,000 was produced in a few months.

By far the most promising development of quartz mining in the district is seen on upper Fairbanks creek. At the extreme head of the creek, Foss and Farvean have a lease on the American Eagle claim, and since installing an Ingersoll stoping-machine they have been steadily increasing the output. The ore is crushed in the Heilig customs mill, 100 tons being reduced recently. The ore assays between $16 and $20 per ton. Another 100-ton shipment will soon be ready. At present, the lessees are working the 'stoper' with steam, which, while uncomfortable to work with in the stopes, is so far ahead of hand drilling that they are quite satisfied with its performance.

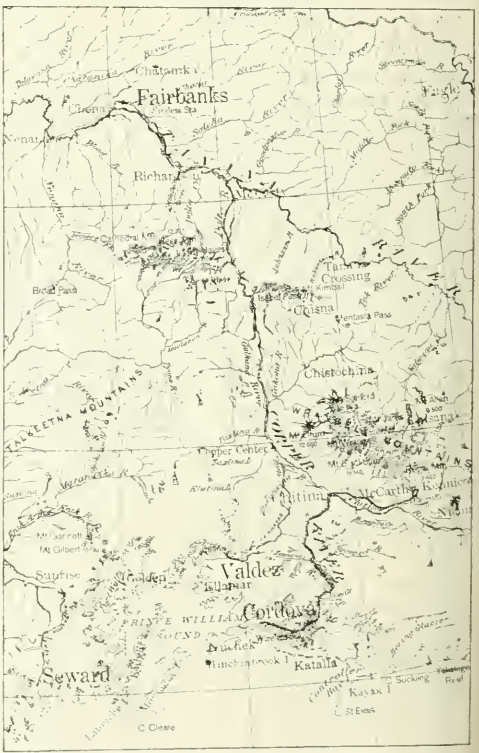
Lately, 38 tons of ore has been shipped to the Heilig mill by August Hess from the Mispah mine nearby. The ore returned $46 per ton. Development is being hastened. On another claim owned by the same people, (Hess, Geis, and Thompson) Ott and McGowan are working a lease and expect to have ore extracted in a few weeks.

T. Gilmore has recently acquired a large interest in Fairbanks Creek properties by buying into the McNeil-Huddleston property, and a half share in the Stevens-Connors claims. A 5-stamp Allis-Chalmers mill is being erected on the latter mine, provision being made for another five stamps later. The plant will be finished early in September. The first run will be on 100 tons from the McNeil-Huddleston-Gilmore property. The main supply of ore for the mill will be drawn from the Gilmore-Stevens claims where a 7-ft. vein, averaging from $12 to $15 per ton, has been developed. At least 10 months' ore is blocked out. There was 175 tons crushed at the Heilig plant to test the shoot. As both the new and the Heilig mills are on the same claim, and most of the producing properties are within a mile of both, a township is growing in the vicinity. The left limit of Fairbanks creek, at this point, has always been thawed ground, and a high channel making water available in large quantities makes of it an ideal mill-site. Heaton & Miller, lessees on a small cross lead on the Stevens-Gilmore ground, have just treated 100 tons at the Heilig mill. The returns were far from satisfactory, and the lease will probably be abandoned.

Goyette and Mareno, a claim-length down the creek, say they have cut the extension of the large Stevens-Gilmore vein. No test of the ore has been made so far.

On the group of eight claims owned by Cook Bros., Lundblad, Hopkins, and Drury, still farther down the hill, Drury and Lamprecht have opened an ore-shoot with a 30-ft. prospect shaft and 75 ft. of drifts in the last two months. Twenty-five tons of ore has been milled by the lessees, the clean-up netting $663 after paying bank charges. If the rest of the ore blocked out yields as well, more extensive development will be undertaken.

It will be interesting to compare the work of the two small quartz mills; Gilmore's five stamps and the Heilig Huntington mill. The capacity of the 3½-ft. Huntington is equal to the five stamps on the same ore crushing through the same screen, 15 tons per day can be reduced by the former through 40-mesh. In fact, several runs have shown that a ton an hour was being crushed. The fuel costs are also undoubtedly lower for the Huntington, judging from the records of other five-stamp mills in the district. The only trouble with the Huntington mill was caused by the necessity of using roll-shells cast at a local foundry, while waiting for some made by the Standard Steel Co. The local product showed the structure of Swiss cheese when broken, and lasted about a week. There can be no doubt that with good shells, the muller-shaft bearings in the hanger, as in the improved mill, instead of in the roller-head, and then substituting a Hyatt roller-bearing in the



PART OF NEW MAP OF ALASKA ISSUED BY THE U. S. GEOLOGICAL SURVEY.

hanger instead of the bushing, the Huntington mill will compare with any roller mill on the market for the work here.

The drag-line scraper for open-cut work, built by Hanot Bros. in a local shop last winter, is proving a great success. A great saving in time and power per load is shown over the old style of scraping direct into the sluice-line, or even to a car that serves the sluice-line. The Hanot scraper is rigidly attached by its bale to a carrier which rides a cable to the dump-box. Slacking the carrier-cable and regulating the length of line to the hoist, the engineer can drop the scraper in any part of the cut. A load is picked up quickly, as the weight of the carrier facilitates digging. Tightening the carrier-cable picks up the load which is quickly pulled to the dump-box, there to be emptied by special trip-line. It is a very flexible system, and will probably be widely adopted by open-cut operators in this district.

It is certain that the new Tolovana district will at least be a small one. While no high-grade 'pay' has been found as yet, there is a good area that can be profitably worked. The

ground so far sluiced has produced about 700 oz., and showed the ground to average between $1.50 and $1.25 per sq. ft. of bedrock. Operations have been hindered by lack of supplies and high prices, but the new road now being constructed will better these conditions. The road will connect with Olnes on the Tanana Valley railroad, and is being made by the Road Commission, aided by $5000 in funds subscribed by Fairbanks citizens. So far, Livengood creek is the only area where pay has been found, and most of production has been made by Patterson and Finley. Late arrivals from the district, however, state that pay has been found in one hole on Mike Hess creek, which is separated by a low divide from Livengood creek and flows to the Yukon side.

The demand for antimony has had the effect of starting real production in this district. Two hundred tons went down the river on the last boat, and much more will be shipped by way of St. Michael before the freeze-up. The shipment consisted of 25 tons mined by Jack Leach of Ester creek, and the remainder was produced by E. L. Scrafford from the head of Wildcat creek. The latter deposit has at least several thousand tons developed, which, considering that it has been opened in the last two months, is good. As antimony has been considered practically worthless here before on account of high freight rates and low prices outside, no properties have been developed before the present demand made it profitable. Many promising prospects are known in the vicinity of Fairbanks, and a rumor is afloat that one of the largest of these will soon be exploited on a large scale.

KALGOORLIE, WESTERN AUSTRALIA

Discovery at Mt. Holland.—Horse-Shoe Developments.—Edna May Flooded.—State Assistance in the Shape of Treatment Plants.—Calc-Schist.—Gravel Deposits.

A discovery was made in July at Mt. Holland, half way between Southern Cross and Hopetoun on the south coast, and 90 miles south of the former place. Four parallel quartz lodes have been found, but no work to prove anything has yet been done. The Edna May Golden Point and Junction companies, at Westonia, have closed down, and G. Stokes, the manager, with a dozen men, has left for Mt. Holland to prospect four leases comprising 96 acres, on which an option has been taken. Mr. Stokes states that the vein is 46 in. wide, and worth $8 to $40 per ton. Three other areas have been acquired by Melbourne people on which men will be working shortly. Luckily rain continues, 3 in. falling during July. As a rule, the Mt. Holland district is too dry for prospecting, and the most will be made of this abnormal season.

The report of Torrington Blatchford, government geologist, on Mt. Holland, is very disappointing after the wonderful reports published by prospectors and others. Mr. Blatchford stated that carefully broken samples of the lode exposed in trenches, panned by himself, were low and scarcely payable. Taken as a whole, the reports of the field have been much exaggerated, and against such the public should be warned. R. G. Stokes, who took an option on Colreavy's reward leases, confirmed prospectors' reports, and gave results of $7 to $40, and an average of $15 per ton.

The latest estimate of the Golden Horse-Shoe's ore reserves is 814,280 short tons worth $7.76 per ton, compared with 800,000 tons of $7.28 ore a year ago. Development on No. 4 lode has been very satisfactory on the four bottom levels. It is likely that the revenue and profit will continue to improve. Work on No. 2 and 3 lodes at the south end of the mine has not been so satisfactory, but J. W. Sutherland, the manager, is satisfied that further exploration will materially improve the position.

Work at the Edna May has been delayed by water at the 300-ft. level, but the lode was cut early in August. The manager, M. T. Williams, reports that the pumps are lifting 720,000 gal. per day.

Since its inception in 1897, the State Government mill system, now consisting of 34 plants in all parts of the State, has treated 1,017,560 tons of ore for $18,468,800 by amalgamation, $2,536,600 from sand, $529,900 from slime, and $16,600 from slag, etc, a total of $21,551,900. According to official figures, the operating loss was $270,000, but the recovery of this large amount of gold has been a great benefit to many. Tin ore has also been treated by the mills for prospectors to the extent of 68,260 tons, returning $423,100, and without this aid the tin would have remained, like most of the gold, in the ground.

The manager of the Kalgurli mine, R. S. Black, has announced that, including July, the grade of ore treated and profit earned will be reduced. This step has been expected, as no sinking has been done since July 1910, when the calc-schist area was entered. In the Lake View mine a good shoot of ore has been opened in calc-schist at 2100 ft. However, there is no doubt that the calc-schist has seriously impoverished the lodes, and a gradual decline is inevitable, so far as the Golden Mile is concerned.

A recent flotation in Melbourne, Victoria, is the Nullagine Mining Co., with a capital of $250,000 in 100,000 shares of $2.50 each. Well known Australian men are interested. The property in the northwest is estimated to contain 600,000 tons of gravel, with a recoverable value of $425,000. The cost of working is stated as $215,000. From 1,000,000 to 2,000,000 tons of lower, but unstated, grade material is said to exist. Previous attempts to work the deposit proved unsuccessful.

In June, gold mines in this State yielded a total of $2,151,000. Dividends amounted to $648,360. Some of the yields were as follows:

Name	Tonnage	Value	Profit	Dividend
Great Boulder	18,640	$242,950	$129,600	$328,100
Kalgurli	10,390	104,300	58,700	.....
Golden Horse-Shoe	23,977	196,670	45,200	225,000
Ivanhoe	19,852	159,700	45,100	.....
Edna May	2,766	61,700	40,480	32,140
Sons of Gwalia	13,542	101,600	26,980	40,620
Sand Queen	2,100	42,000	25,500	22,500
Fenian	3,216	46,300	22,300	.....
Lake View and Star	18,152	106,600	17,700	.....
Perseverance	20,827	117,600	17,300	.....
South Kalgurli	9,630	61,900	11,100	.....
Bullfinch	6,385	40,000	11,000	.....
Ingliston Consols	2,115	20,300	10,100	.....
Victorious	3,764	26,600	7,500	.....
Mararoa	2,690	24,200	6,500	.....
Menzies Consols	2,351	25,500	4,500	.....
Yuanmi	4,478	39,600	3,600	.....
Associated	10,455	61,000	3,500	.....
Oroya Links	12,000	64,800	3,300	.....
Associated Northern	381	19,500	2,900	.....
Commodore	740	7,700	2,100	.....
Great Fingall	5,030	39,000	1,400	.....
Golden Ridge	1,510	12,200	1,000	.....
			Loss	
Edna May Central	1,830	7,100	1,600	.....
Ida H.	1,357	23,400	4,500	.....

The report of the Great Boulder Perseverance company, Kalgoorlie, for the quarter ended June 30 contains the following:

Development, feet	876
Broken ore in stopes, tons ($5.40 per ton)	261,366
Ore treated, tons	61,212
Value of gold and silver (15,662 oz. and 3492 oz.)	$322,000
Operating costs, per ton	$ 4.40
Profit	$ 31,000

Work in the southwest part of the mine at 900 ft. resulted in a lode being opened, the present length being 60 ft. The company has decided to do little more development, but treat only the ore from the present stopes.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Fairbanks

Representative business men of Fairbanks have visited the Tolovana district, and returned optimistic. Mike Hess and Livengood creeks are yielding good returns.

Ketchikan

(Special Correspondence.)—The mining possibilities of this district are being more fully realized, owing partly to the resuscitation of several properties.——The Granby Consolidated is shipping nearly 12,000 tons per month from the Mamie mine at Hadley, and over 3000 tons from the It near Kasaan. ——Preparations are being made to ship high-grade ore from the Goodroe mine at Karta bay. A large quantity of concentrating ore has been developed in this mine. Some platinum has been reported besides the gold and copper contents.—— The Rush and Brown continues to ship steadily, producing about 1000 tons per month.——Axel Carlson has leased the Cymru mine at North arm, and is almost ready to make a small shipment.——Ickis and Polson have reached a vertical depth of 135 ft. in their lower adit at McLeans arm. The upper adit is in 40 ft., with 30 ft. of backs, showing 24 in. of high-grade gold-copper ore.——Four gold mines are operating on a small scale.

Ketchikan, September 10.

ARIZONA

Greenlee County

Unless the mining companies at Clifton, Morenci, and Metcalf can settle the wage dispute, they will close their properties for six months or more. Although many Americans were employed, the Mexicans are mostly affected by the strike. Wages are based on the price of copper.

The Shannon Copper Co. reports as follows for the second quarter of 1915: ore treated, 72,999 tons; copper produced, 2,867,000 lb.; gold, 320 oz.; silver, 16,100 oz.; profit from mine, $160,259; profits from railway, $4389; excess of assets over liabilities, $507,674. Costs were reduced considerably. A 150-ton leaching plant is to be erected to treat slime and other material. This will be increased to 500 or 600 tons if successful.

Mohave County

At 375 ft. in the Gold Reed mine at Oatman some good ore was opened last week.——The Big Jim shaft is down 160 ft., and prospects are considered to be bright. Machine-drills are used.——The Arizona-White Chief Mining Co. has been incorporated to work at the south end of the Oatman district.—— The property of the Arizona-Tom Reed company is to be developed in charge of G. F. Moser.——The Jerome-Oatman company is sinking. Machinery is to be ordered.——The 200-ton flotation plant at the Golconda zinc mine, at Union Basin, is expected to be ready early in January.

In the *Mining and Oil Bulletin* of the Los Angeles Chamber of Mines and Oil for September is published a résumé of the report of W. H. Weed on the United Western mine at Oatman. The geology of the district is briefly given, and some general remarks on the United Western and United Eastern properties.

Yavapai County

The Bonnie mine, which has been closed for a long time, is to be drained and re-opened. A fair amount of work has been done at the property, which contains gold, silver, copper, and lead ores. R. M. Garrett of Prescott is largely interested.

CALIFORNIA

Amador County

Following is the preliminary report of output and costs of the Plymouth Consolidated for August:

Ore milled, tons	10,800
Total value	$53,236
Working expenditure	29,198
Development charges	1,906
Surplus	$22,132

At 3200 ft. in the Central Eureka some good ore has been cut. Thirty stamps are dropping in the mill.——The old Rose or Poundstone mine, near Sutter Creek, is being unwatered.

Eldorado County

The Nipissing Mining Co. of Canada has taken a bond on the Day mine, three miles northwest of Placerville near the Coloma stage road. The price for the 55 acres is $100,000. The property can be developed by adits. The ore is somewhat refractory.

The Greenwater and Death Valley Copper Co. has closed its property, two miles south of Shingle Springs, for good. Work was only started recently, but results were unprofitable.

From 97 lb. of black sand saved in sluice-boxes during gravel washing on Hangtown creek, near Placerville, two miners received payment at the rate of $2390 gold and 23 oz. silver per ton from the Selby smelter.

Nevada County

The claims of Carter Bros., at Missouri bar, south Yuba river, have been acquired for the Hearst interests by Stuart J. Rawlings, their engineer.

Rich gold ore, valued at over $40,000 has been found at Sacramento. It is supposed to have come from the Empire mine at Grass Valley. Arrests have been made.

The Brunswick company at Grass Valley is employing 150 men. A dividend of 6c. per share, $24,000, is to be paid.

Shasta County

It is said that the Balaklala company will ship ore to the Tacoma smelter, Washington, in addition to the 125 tons daily to the Mammoth smelter at Kennett.

A 5-ft. vein has been cut in the Greenhorn mine which is producing rich ore. Shipments are to be increased to 20 tons per day.

Sierra County

The Sixteen-to-One mine is producing some good ore again. Twenty men are employed; also 10 each at the Oriental and Golden Fraction mines. These are near Alleghany.——Near Forest, a shaft is being sunk at Rock creek to cut the north extension of the Bald Mountain extension gravel channel. It is down 76 ft., having passed through strata of hard and soft lava.

COLORADO

Lake County (Leadville)

At the Penrose shaft the pumps are nearly down to 600 ft. depth. Everything is working well.——Extensive development is under way at the Susquehanna mine at the head of Lackawanna gulch. The adit is in high-grade silver ore.——Rich gold ore continues to be extracted from the St. Louis adit.—— Lessees at the Reveille have opened a shoot of rich gold ore. ——A large area of placer ground above Twin Lakes is being prospected by local people.

Park County

Just over the line from Lake county the Hill Top mine is employing over 50 men. A good deal of lead-zinc ore is being extracted. Denver people own the property, which is in charge of S. Doran.

IDAHO

Shoshone County (Coeur d'Alene)

The Stewart Mining Co. will distribute 10c. per share, or $123,836, on September 30. This makes $681,099 for the year, and $1,981,507 to date.——The Frisco mill of the Federal company is closed for an overhaul.——The Mark Cooney claims near Burke have been acquired for Eastern people by W. M. Neary of Spokane for $150,000. Three 200-ft. adits have been driven, and good lead-silver ore opened. Machinery is to be ordered for new equipment.

Under the auspices of the Coeur d'Alene mine operators, American Mine Safety Association, and U. S. Bureau of Mines, a great first-aid contest was held at Wallace last week. The following teams, consisting of six men each, were entered: Morning mine, one team; Interstate-Callahan, one team; Tamarack & Custer, one team; Success, one team; Bunker Hill & Sullivan, two teams; Stewart, one team; and Hecla, two teams. The contest consisted of a one-man, two-men, three-men, and a full-team event. Each consisted of the solution of one problem selected from four, the contestants not knowing which problem would be selected. In the full-team event 15 minutes was allowed, in all other events 10 minutes. The work of the teams was of great interest, and all showed a surprising degree of proficiency, according to the *Wallace Miner*. Following are the results: Hecla, underground, 99¾; Hecla, outside, 98⅞; Bunker Hill & Sullivan, outside, 98½; Bunker Hill & Sullivan, underground, 97¼; Tamarack & Custer, 97¼; Morning, 96⅜; Stewart, 94¼; Interstate-Callahan, 93; and Success, 91⅛. A banquet, at which 120 attended, including the contestants and representatives from the companies, was held in the evening. It was decided to hold a contest in 1916.

MICHIGAN

The Copper Country

A considerable amount of diamond-drilling is being done throughout the district, from Keweenaw through Houghton and into Ontonagon county, the White Pine, White Pine Extension, Onondaga, and Nonesuch being in the latter area.

At the Mass mill the second stamp will be followed by rolls. This will increase the tonnage by 200 per day. The present quantity is between 32,000 and 35,000 tons per month. A third compound stamp may be required soon; this will cost $25,000.

MISSOURI

Jasper County

Between midnight on September 14 and 8 a.m. on the next day 7.1 in. of rain fell at Joplin, the heaviest fall ever recorded. Damage is estimated at $500,000. Many mines were flooded, the Napoleon mine having 80 ft. of water. At Carthage 9 in. was registered.

Last week Jasper county voted a bond issue of $100,000 to pay for the erection of a tuberculosis sanatorium.

MONTANA

Fergus County

During August the Barnes-King company's North Mocassin mill treated only 1464 tons of $9.90 ore on account of litigation. The Piegan Gloster mill treated 1800 tons yielding $16,000.

Lewis and Clark County

(Special Correspondence.)—The Wickes Corbin Copper Mining Co. in the Wickes-Corbin district has leased and bonded part of its property to Oskar Karri and associates of Butte for $250,000, on two years' time. This property is considered one of the most promising in the district, having been under development by the owners for the past seven years. The shafts now being sunk are all in a good grade of copper, silver, and lead ore, shipments of which will be started within a short time.

The Cullen-Miller company in the Scratch Gravel district has cut its vein on the 200-ft. level. The shoot is two feet wide and contains high metal-content. This vein is an extension of the one being worked in the Franklin mine, which still continues shipments.

Huffaker and Hill are shipping ore from the Eastern Bell, which was leased and bonded by them from the Helena Mining Bureau. One car averaging $25 per ton has been shipped, and another one is being loaded. The vein, which started flat, has turned down at an angle of 45°, and is four feet wide with higher value.

Helena, September 8.

Mineral County

The mill at the Iron Mountain mine, near Superior, east Coeur d'Alene, is being enlarged to treat 250 tons per day. A large deposit of zinc and lead ore has been developed. One hundred and twenty-five men are employed.

The Inter-Mountain company's new 125-ton mill at the Amador mine is nearly ready. There are 50 men employed.

Silverbow County

Wages paid by all industries at Butte in August totaled $2,500,000. The following mining companies contributed: Anaconda, $1,180,000; Butte and Superior, $170,000; North Butte, $93,000; East Butte, $90,000; and Clark interests, $60,000.

NEVADA

Nye County

Five companies and several lessees at Tonopah last week produced 9861 tons of ore worth $203,458.

August outputs are as follows: Belmont, 15,104 tons yielding 250,636 oz. bullion and $68,824 profit; Jim Butler, profit of $31,553 from 4800 tons; and Tonopah Mining, 12,280 tons for 216,300 oz. bullion and profit of $57,220.

North from 601 winze in the West End the faulted vein has been cut again.——Lessees at the Montana are working steadily.

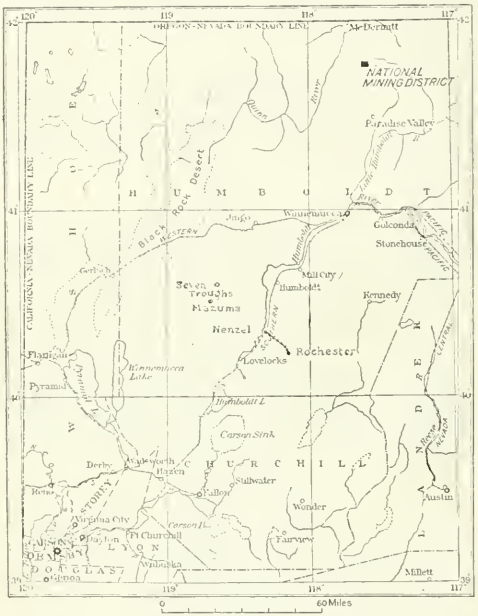
White Pine County

The Nevada Consolidated company's *Safety-First* for August states that the rate of accident frequency shows little, if any, improvement. The mishaps were as follows: Copper Flat steam-shovel mining, 7; Ruth mine, 6; mill, 2; and smelter, 1. The Congress safety shoe is advised to be worn in the smelter.

Humboldt County

Little is heard of National, a centre which was conspicuous some time ago on account of the rich ore extracted from the National vein (between $3,000,000 and $4,000,000 to the end of 1912), and the great apex suit that continued for years. In Bulletin 601 of the U. S. Geological Survey the geology and mineral deposits of the National mining district are described by Waldemar Lindgren. The area is situated near the Oregon state line, on the western slope of the Santa Rosa range (which has had an output of $7,000,000 since 1869), being reached from Winnemucca, 70 miles south, by stage and auto. Gold was discovered in 1907 by J. L. Workman, but the rich shoot was found in the next year. The history of the district is practically one of the National mine, namely, rich ore, high-grading, and apex suits. The mineral deposits at National are narrow fissure veins with a northerly trend and steep east or west dip. They intersect latite, rhyolite, basalt, basalt tuff, and trachyte. They are therefore distinctly later than any rock in the district. None have been extensively developed, save the National vein. The characteristic mineral is stibnite, but veins that contain much of it are usually poor in gold and silver. The veins of the district are essentially silver bearing of moderate value; the gold shoot in the National vein is

a unique occurrence in the district. In the National mine there is good evidence of deposition of secondary sulphides below water-level. The most abundant is marcasite, also pyragyrite and stibnite. The gold deposit was found 40 ft. below the surface, and has been followed on the dip for 800 ft., the stope length being 250 ft. Its output is about $3,500,000,



MAP SHOWING THE NATIONAL DISTRICT; ALSO SEVEN TROUGHS AND ROCHESTER.

partly by local treatment and partly by smelting. The National Mammoth Mining Co. drove three adits near the National mine. In 1911 the National Mines Co. sued the Charleston Hill National Mining Syndicate and the Mammoth Mines Co. for alleged trepass. Well known geologists were retained by both sides, in which the complainant won. The bulletin covers 55 pages with maps and illustrations, and is very interesting.

Shipments of antimony ore from Lovelock last week amounted to 26 tons averaging 50% metal. It was extracted from a property of J. H. Causten, T. Thornberry, and W. Harrigan, near Antelope Springs, 21 miles east of Lovelock.

NEW MEXICO

SANTA FE COUNTY

The Santa Fe Gold & Copper company produced 289,766 lb. of copper in August. The output of 837,577 lb. in three months yielded a profit of $74,130. Copper matte is sent to the A. S. & R. plant at Omaha. Some 4 to 15% ore has recently been opened in the mine. The average of the mine is 2.5%. Some ore contains $1.59 gold per ton. Mining costs $1.75, and smelting $2.37 per ton.

NORTH CAROLINA

YADKIN COUNTY

(Special Correspondence.)—At the Gross and Dixon Gold Mining Co.'s mine the incline shaft is 200 ft. deep. Development continues, and a good deal of ore has been blocked out. Within 60 days the stamp-mill and new cyanide-plant will be in operation.

Cana, September 9.

OREGON

MARION COUNTY

(Special Correspondence.)—The Santiam or Lister River mining district is tucked away in a corner of the Cascades, only about three or four miles from the north and south promontory that makes the Clachamas watershed to the north and the Santiam to the south. This part of the country has been heavily timbered and burned, and is now covered with a heavy growth of underbrush, hence it is hard to prospect. However, it was prospected in the early days, and while the early explorers were chiefly looking for gold, yet they found some promising veius. All of them are heavily mineralized from the surface down, hence they did not show their contents in panning by the first prospectors. The lodes were later taken up by other men, and gradually opened. Among this group is one known as the Consolidated Copper, located about 15 years ago by Hugh Freeland, an old prospector from Butte, Montana. He has driven an adit 190 ft., and the whole face will average $12 or over per ton. A small company was organized by Lotz, Larsen, and associates, and it has taken over the ground on a long lease and bond. A car of ore assaying 20% copper and about $5 per ton gold and silver is being extracted. This ore will be easily treated, and should be in demand at smelters on account of its value as a flux. Four men are at work; this number will be increased from time to time. It is proposed later on to install a flotation plant of 100-ton capacity and concentrate the ore, on account of the great distance from market.

Farther up Gold creek is the Gold Creek Consolidated, where, under the direction of Mr. Ormsby, the camp is fairly busy. The power-house has been altered, and an additional 50-ft. head is available, and all the power necessary for the compressor and other purposes is available. The adit has 600 ft. more to go to cut the vein. Within 30 days there will be a full crew at work.

Farther up the creek is the old Lewis & Clarke property, containing high-grade lead and zinc ores. It is under lease and bond to an old miner. Prospects are good.

Gates, September 11.

TEXAS

The mineral resources of Texas are discussed in Bulletin 365 of the University of Texas at Austin, by William B.

WESTERN TEXAS.

Phillips. With 40 illustrations and index it covers 362 pages. In 1913 the mineral products were listed under 22 general items. The total output in that year was $31,666,910. The total since 1882 is $268,161,519, of which petroleum contributed 40.6%; clay products, 17.9%; coal, 13.3%; cement, 3.7%; silver.

3%; and quicksilver, 0.9%. The publication gives in detail the area, value of property, mineral occurrences, and mine operations in each county: also the law relating to prospecting on school lands, and a great deal of other statistical matter.

Cherokee County

(Special Correspondence.)—It is proposed to re-open the iron deposits at Rusk, also some in Cass county. The University of Texas, in its recently issued Bulletin 365, covers these deposits which are found in an area of 1250 to 1300 miles.

Austin, September 10.

El Paso County

(Special Correspondence.)—As evidence of the activity in the mineral region of the Southwest, from which the smelter of the American Smelting & Refining Co. at El Paso draws its ore supply, it is officially announced that plans have been adopted for making improvements and additions to that plant at a cost of about $300,000. The most important feature of the proposed work is three large converters, which will increase the converter capacity about 33%. The new converters will be of steel, lined with brick, each 30 ft. long, and with an outside diameter of 15 ft. Large electric cranes, to carry the molten metal from the furnaces to the converters, will be installed. They will replace the steam tramways which are now in use. Plans are being drawn for a new smokestack 300 ft. high. It will probably be built of brick. A dust-chamber will be constructed.

El Paso, August 26.

UTAH

Juab County

Tintic mines produced 121 cars of ore last week. The use of electric power for hoisting, pumping, milling, and other purposes in this district is rapidly extending. Large motors are at work, and are to be installed. The Utah Power Co. supplies current. Leasing is profitable and popular at Tintic at present, and several hundred lessees are at work. As much as $1600 has been received for a single car of zinc ore. Some rich silver-gold-lead ore has been opened in the Yankee Consolidated. A depth of 1300 ft. has been reached in the Tintic Standard.

Salt Lake County

The Alta Prince adit, Little Cottonwood district, is in 1000 ft., the ground being white limestone containing galena. The objective point is the intersection of the Prince of Wales fissure with the contact between white and blue limestone.——Better ore is showing in the raise on the Toledo fissure in the Columbus Extension.——A recent shipment from the Wasatch mine assayed 70.7 oz. silver, 16.2% lead, 10.9% copper, 18.4% zinc, 6.6% iron, and 0.01 oz. gold per ton. This came from No. 2 workings on the Brain fissure.——On September 25 the Cardiff company paid its initial dividend, 25c. per share or $125,000. The rich ore was cut last October, and has been opened for 225 ft. Daily shipments are 125 tons.——Last week J. Hendrickson and A. E. Eikrem put on oxygen apparatus and went into the Alta-Quincy adit to repair an air pipe, to allow air to go into the Albion mine, where gas had accumulated. Both were overcome with gas, the latter was rescued but the former was found dead. A large quantity of water is flowing from the face of the drift.

The Utah Metal & Tunnel Co. at Bingham is mining 125 tons of $16 lead-silver and gold ores per day. Work is being done 1200 ft. in from the Bingham entrance of the 13,000-ft. tunnel connecting upper Bingham with the Tooele side of the mountain. The shoot is in limestone.

Summit County

A total of $326,250 will be paid in dividends by Park City companies on October 1. Details are as follows: Daly-Judge, 20c. per share, $75,000; Silver King Coalition, 15c., $187,500; and Silver King Consolidated, 10c., $63,750.

WASHINGTON

Ferry County

(Special Correspondence.)—The Midget Gold Mining & Milling Co. has leased the Tom Thumb mine, one of the most valuable properties in the Republic district, for three years, to Z. E. Merrill. Under the superintendency of E. J. Delbridge the mine is being unwatered, and needed repairs are being made. The roadbed of a Great Northern railway spur from the Ben Hur mine, two miles, to the Tom Thumb is being re-ballasted, and the track re-laid for the transportation of ore from the latter to the smelters. It was estimated that the Tom Thumb had approximately 10,000 tons of ore opened, valued at $10 per ton, when it was closed five years ago for want of local treatment. The property is well equipped with hoisting and pumping machinery, air-compressor, and electric-light plant. In September, 1909, J. L. Harper took a lease and option on the property for the New Republic company, and operated it for a few months, and in the following spring sub-let it to other people. During this time about 25,000 tons of ore was mined and shipped. The Tom Thumb is opened by an incline shaft on the vein, a vertical working shaft, down over 400 ft., a cross-cut on the 230-ft. level, drifts on the vein connecting the old and new workings, and much other development work. The workings will admit of 15 to 20 men being employed to advantage on each shift. The mine is situated at the extreme north end of Republic and the leasing operations will be of importance to the district.

Republic, September 17.

Thirty-seven tons of ore from the Knob Hill mine sent to the Trail smelter returned 2.4 oz. gold and 7.2 oz. silver per ton, and a net profit of $1545. Nine cars of similar ore are on the way to the smelter. Average monthly profit this year is $10,000.

Stevens County

The Norman Mines Co., of which Sidney Norman of Spokane is manager, has taken over the Great Western property, adjoining the Last Chance mine, seven miles from Northport. The mine has produced lead worth $500,000.——The Blue Star Mining Co. of Chewelah, owning the old Eagle Lode claim and other properties at Chewelah, has bonded all of its claims to Cecil R. Gould of New York for $60,000. Mr. Gould has also purchased the properties of the New Currency Mining Co. of Chewelah for $30,000.

CANADA

Alberta

The mineral production of this Province in 1914 totaled $12,684,234, against $15,054,046 in 1913. Coal accounted for $9,350,392, natural gas; $1,214,670; cement, $1,212,342; and gold, $992. The Province contributes about 9% of the total of the Dominion.

Between Banff and Laggan, the Alberta Copper Co. has acquired six claims containing good ore, 3000 ft. above the Canadian Pacific railroad. An aerial tram is to be erected.

British Columbia

The Annual Report of the Minister of Mines, Richard McBride, and that of the provincial mineralogist, William Fleet Robertson, for the year 1914, is just to hand. In its 544 pages and illustrations a great deal of valuable information is available. The mineral output was valued at $26,388,825, a decrease of nearly $4,000,000 due to the state of metal market late in the year.

The Granby Consolidated company's smelters are at full capacity, according to the general manager, Frank M. Sylvester. With eight furnaces in blast the Grand Forks plant is treating 100,000 tons of ore per month; with four at Anyox the quantity is nearly 80,000 tons. Over 850 men are employed at the latter property. The Mamie mine on Prince of Wales island is supplying some ore for the smelter, also the Midas mine at Valdez. The company is encouraging miners in north-

ern British Columbia and Alaska as much as possible, but not much custom ore has been received. About the only considerable shipper has been the Rocher de Boule mine near Hazelton, which sent 6000 tons in the last two months.

On October 10 the Standard Silver-Lead company of Silverton will pay 2½c. per share, equal to $50,000. This makes $100,000 for the year, and $1,650,000 to date.

The Provincial government is to aid financially the concern that is establishing a zinc smelter at Nelson. The old Fairview plant will be used.

ONTARIO

A train that left Cochrane for the Kowkash goldfield on September 8 was crowded with prospectors, also a box-car full of canoes. A train that came in from the west carried returning prospectors. They consider the rush not warranted. An official of one of the Porcupine companies was pessimistic on his return. He said there was no rock to prospect, but nearly all muskeg (a swamp). Others are optimistic, bringing back rich samples of ore.

During August the Nipissing high-grade mill treated 139 tons of ore, while this and the low-grade plant yielded silver worth $179,048. It is considered probable that the Cobalt Lake fault will be found in Nipissing ground at depth.

The Alexo nickel mine at Porquis Junction produced 766 tons of ore in August.

During the period ended August 12 the Hollinger mill treated 29,955 tons of ore averaging $9.03 per ton. Operating costs were $3.287 per ton, and gross profit $147,289.

An incline shaft is to be sunk at the Dome mine, as the present main shaft is in ore, making operation awkward. Good developments are reported from 700 ft. depth.

The new Schumacher mill is working satisfactorily.

YUKON

A great deal of road repairing has been done in the Dawson district this season by the Government. Some roads have been widened to 24 and 30 ft., with good crowns in the centre.

The Mayo silver-lead field is developing well. More prospectors are wanted, not men looking for work. At a banquet at Mayo last month to Alfred Thompson, member of parliament, the meat, vegetables, and flowers were Yukon products.

MEXICO

(Telegraphic Correspondence.)—Instructions State Department to consuls Villa territory urging all Americans and other foreigners leave has resulted in smelters, mines, industries, closing down. Foreign employees have left, Mexican employees discharged, excepting few watchmen or few cases moderate development continuing. Velardena smelter and mines, Mapimi, Chihuahua, Santa Eulalia mines and smelter at Terrazas station, mines Cusi district and others in western part of State all closed. Consuls, merchants, and nearly all American citizens are out or coming out from towns. Train service irregular, country quiet, no disturbances, and order preserved.

El Paso, Texas, September 22.

DURANGO

A consolidation has been effected of the Candelaria, the Contra Estaca and LaPuerta, and the Pilar mines in the San Dimas district. The new officers are D. M. Burns, president; Forest B. Caldwell, vice-president and general manager; and Charles Dunphy, secretary. Included in the above merger is also the San Dimas Power Co., which has prepared plans for the erection of a hydro-electric power-plant with necessary transmission-lines to serve all of the above mines. The present equipment consists of a 110-ton mill at the Candelaria, and one of equal capacity at the Estaca. The ores are silver-bearing, and the all-sliming process is used, employing the Dorr counter-current system with Oliver vacuum-filters. The offices of the company are in the Crocker building, San Francisco, and the Mexican address is San Dimas, Durango, Mexico. Mazatlan is the port of entry.

PERSONAL

J. R. FINLAY is at Butte.

ALBERT BURCH has returned from Butte.

F. L. RANSOME was at Goldfield recently.

LEO VON ROSENBERG is in Eastern Oregon.

F. LYNWOOD GARRISON has gone to Tucson.

KIRBY THOMAS was at Pioche, Nevada, recently.

H. E. WEST has returned to Berkeley from Peru.

CHARLES WILL WRIGHT has returned to Sardinia, Italy.

CHARLES S. HERZIG is in the San Juan region of Colorado.

J. C. GREENWAY, from Warren, Arizona, is at the Fairmont hotel.

HARRY L. DAY, of Wallace, Idaho, is attending the Mining Congress.

W. L. HONNOLD is now working with the Belgian Relief Commission.

BEN. B. LAWRENCE is due at Spokane on October 1, and later in San Francisco.

GEORGE A. DENNY reached Liverpool on August 30, on his return from Mexico.

WILLIAM H. KNOWLES, of Sonora, California, formerly in Colorado, was here last week.

GEORGE M. RICHARDS has returned from a three years' reconnaissance in the Belgian Congo.

H. R. VAN WAGENEN is expected in San Francisco, from Pioche, Nevada, early in October.

P. B. MCDONALD will join the editorial staff of the MINING AND SCIENTIFIC PRESS at the end of the current month.

H. FOSTER BAIN was in Cornwall early in September, where he read a paper before the Royal Cornwall Polytechnic Society.

J. J. CARRIGAN, Safety-First engineer for the Anaconda company, has been attending the First-Aid contest at the Exposition.

JAMES CALLAHAN, a pioneer of the Coeur d'Alene, Idaho, and a large shareholder in the Interstate-Callahan zinc mine, is ill at Wallace.

F. C. NEWTON has resigned the superintendency of the Perth Amboy smelter to become manager for the Newton Manufacturing Co., at Lowell, Mass.

GUY C. RIDDELL has returned to East Helena, after a month spent in inspecting smelting plants in the Middle Western and Rocky Mountain states.

W. RAY COX, who for several years has been a Mineral Inspector of the General Land Office at Portland, Oregon, has been appointed Professor of Mining and Metallurgy in the School of Mines at the Oregon Agricultural College, Corvallis, Oregon.

J. H. FARRELL has resigned the position of consulting engineer to the Yellow Aster Mining & Milling Co. He directed development work at the Yellow Aster mine for a year following the completion of a geological examination of the Randsburg property.

Schools and Societies

The Cobalt branch of the CANADIAN MINING INSTITUTE entertained the Porcupine branch last week.

The INDUSTRIAL ACCIDENT COMMISSION will hold the second public hearing to consider mine-safety rules for California today, September 25, at 407 Underwood building, 525 Market street, San Francisco, commencing at 9:30 a.m. At the hearing which was held on June 11, 12, and 14, a number of sections were sent back to the committee to be re-drafted. Most of the discussions will be on these re-drafted sections.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, September 23.

Antimony	35 —35¾
Electrolytic copper	18½—18¾
Pig lead	4.75—5.70
Quicksilver (per flask)	$90
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	29

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, September 23.—Copper is quiet but firm; the lead market is dull though steady; zinc is firm owing to scarcity, futures neglected.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Sept. 16	17.75	Aug. 11	17.94
" 17	17.75	" 18	16.89
" 18	17.75	" 25	16.27
" 19 Sunday		Sept. 1	17.83
" 20	17.75	" 8	17.62
" 21	17.75	" 15	17.42
" 22	17.75	" 22	17.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended September 4 totaled 4,033,092 lb., valued at $714,882. Of this, 1,782,452 went to France, 1,338,642 to England, 467,684 to Norway, and 360,757 to Denmark. Imports amounted to 4,187,155 lb. worth $569,011. Canada sent 1,871,555; Cuba, 1,232,000; and Chile, 1,136,000 pounds.

It is considered that the production of metal in the United States exceeds domestic consumption and exports by 24,000,000 lb. per month, and new producers are making large outputs.

In the quarter ended August 31 the Kennecott properties, Alaska, yielded 23,000,000 lb., with a net profit of about $3,250,000. Some 70% ore has been sent to Garfield, Utah. Braden yielded 2,858,000 lb. for 8 months of 1915, against 18,315,000 lb. in 1913. The Champion company, Michigan, is to pay $2 per share, making $21 since January.

The American Smelting & Refining Co.'s report for the first half of the current year is to hand. The net income available for dividends was $5,019,982, an increase of $53,290 over that period of 1914.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept. 16	48.37	Aug. 11	47.27
" 17	48.75	" 18	47.33
" 18	48.62	" 25	47.08
" 19 Sunday		Sept. 1	46.77
" 20	48.75	" 8	48.20
" 21	49.37	" 15	48.56
" 22	49.25	" 22	48.85

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The silver market is showing a better undertone. This may be due to purchases by the United States Mint, 4,375,000 oz. having been bought since August 1, an amount equal to the total bought in 1914. The recent rise in prices resulted in 486,929 oz. leaving Cobalt last week, making a total of 6,068,538 oz. for the year, also an increase in ore shipments. About 240,000 oz. arrived in San Francisco from Mexico last week. London advice states that supplies are restricted, partly due to the low rate of exchange two weeks ago. Continental purchasers have increased.

Since the beginning of the War 10,800,000 oz. silver has been coined in Germany. The 'Frankfurt Gazette' reports that only 18 marks per head of population has been coined out of M20 authorized. This metal is said to be from German mines.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug. 25	95.00	Sept. 8	95.00
Sept. 1	95.00	" 15	90.00
		" 22	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

The quicksilver market is strong. On October 1 the New Idria company will pay 50c. per share, making $1,730,000 to date. The last dividend was 10c. on April 1, 1914.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Sept. 16	4.50	Aug. 11	4.79
" 17	4.50	" 18	4.44
" 18	4.50	" 25	4.49
" 19 Sunday		Sept. 1	4.87
" 20	4.50	" 8	4.90
" 21	4.50	" 15	4.62
" 22	4.50	" 22	4.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Sept. 16	13.75	Aug. 11	15.12
" 17	13.75	" 18	12.21
" 18	13.50	" 25	11.96
" 19 Sunday		Sept. 1	15.75
" 20	13.50	" 8	14.77
" 21	13.25	" 15	13.92
" 22	13.75	" 22	13.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

Prices for ore at Joplin showed little change last week. The output of the Missouri-Kansas-Oklahoma region was as follows: blende, 5059; calamine, 335; and lead, 977 tons, averaging $71.49, $61.23, and $49.91 per ton respectively. The total value was $430,939, and for 38 weeks, $16,690,765.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is dull at 32.50 to 33c. per pound, and £152 per ton in London.

ANTIMONY

Efforts to move a surplus of stock in dealers' hands has caused an easier market, and the range of quotations is about 27.50 to 28.50c., duty paid. For metal in bond 26c. is asked, equal to 28.50c. There seem to have been no results from the large export inquiries reported from time to time. The quotations are confined to Chinese and Japanese grades.

Eastern Metal Market

New York, September 17.

The metal trade in general is quiet and awaiting developments. It is generally admitted that much depends on a favorable outcome of the efforts to establish Anglo-French credit through the medium of the much-discussed and enormous loan. Meanwhile, sellers are marking time. Copper advanced abruptly fully ½c. September 14, and today is strong at 17.87½c. cash, New York, partly because of advances at London and partly on account of the strike of several thousand miners in Arizona. Incidentally it may be remarked that strikes are causing industrial distress in many directions, Bridgeport, Connecticut, has recovered from the trouble; but serious conditions prevail in other parts of New England. A Providence, Rhode Island, builder of machine-tools closed his factory when his men walked out, and it has been idle for weeks. Half a dozen plants in northern New Jersey are hard hit, and manufacturers everywhere are worried. The usual demands are for recognition of the Union, 10% increase in wages, and the eight-hour day. Zinc has been dull, with a tendency on the part of all but very choice grades to decline. Lead has been quiet, and price cutting has been halted by a reduction to 4.50c., New York. Tin has been extremely dull, with spot and futures at the same level. Antimony is a trifle weaker because of pressure to unload surplus stocks. Aluminum is scarce, and the nominal prices range from 45 to 50 cents.

The great demand and high prices paid for semi-finished steel and steel rounds has aroused the interest of the railroads, and started them wondering how their 1916 requirements are to be filled. It is estimated that the inquiry for first-quarter delivery of billets, blooms, and large rounds totals about 200,000 tons. Jobbing iron foundries are doing better, but are not as busy as they should be, and they are slow in buying pig-iron at recently advanced prices. The demand for machine-tools continues heavy, despite the far-off deliveries. Lathes continue to be the most active; but it is noticeable that the call is now for the larger sizes such as are used in making big shells.

COPPER

The market was dull and easy, with electrolytic quoted at 17.25c., cash, New York, until September 14; but on that day there occurred one of the sudden changes now characteristic of all the metals. Electrolytic jumped to 17.75 to 18c., 30 days, delivered, and September 17, it was held at 17.87½c. cash. On the day of the first advance producers sold a few thousand tons at full prices, but it was influences other than buying that gave the market its strength. One of these was the strike of several thousand workers of various kinds at the mines of the Arizona, Detroit, and Shannon copper companies in Arizona, following a refusal to pay higher wages, and the other consisted of advances in the London quotations for electrolytic. The London price advanced on September 14, £1 10s. on the 15th, and 10s. on the 16th, making the quotation £86 10s., equivalent to 18c. delivered at London. The reason for the strength abroad appeared to be an optimistic view of the efforts being made to float a large Anglo-French loan in this country, thereby establishing a credit against which the Allies can continue their purchasing in the United States, without further upsetting our financial equilibrium. The favorable outcome of negotiations in this direction was anticipated, also, by an advance in the foreign exchange market, the pound sterling rate advancing on September 17 to $4.72⅜. French money advanced proportionately. Once an Anglo-French credit is established, a decided change in the attitude of English and French purchasers is looked for, and that this is badly needed is indicated by the fact that copper exports September 1 to 18 totaled only 5427 tons. The following comparative statement of copper exports (in long tons) from the United States during the eight months of this year was compiled by C. Mayer, secretary of the New York Metal Exchange:

Country	1915	1914
United Kingdom	57,015	55,902
France	62,592	47,322
Germany	.....	88,452
Holland	798	51,391
Belgium	.....	2,876
Austria	.....	13,809
Italy	27,916	10,460
Denmark	1,550	.....
Norway and Sweden	11,586	.....
Russia	8,651	125
China and Japan	81	1,640
Sundries	1,597	1,388
Total	171,786	273,365

The consumption of copper in the industrial arts is far from good. For months it has been practically the War demand that has sustained the trade. Lake is quoted at 18c., and a business of several million pounds has been done at that figure.

ZINC

Despite the presence in the market of a few export inquiries, zinc has been dull and easy almost continuously. As with all the metals there is much waiting on the outcome of the foreign loan negotations. The New York quotation on September 16 was 13.75c., prompt shipment, with St. Louis at ⅛c. less. Last quarter shipment was quoted at 13c., and brass-mill special at 16c. A sale of Horsehead was made this week at 40c., showing that the premium for very choice brands is not impaired. Some inquiry for nearby delivery developed on September 16, but sellers were not eager for orders at the prevailing prices. There is a general feeling that production is outpacing consumption; this has a depressing effect. Again the demand for galvanized sheets is not good, and this is not favorable for ordinary prime Western metal. The foreign market has been weak. The exports September 1 to 18 amounted to 1988 tons.

LEAD

The A. S. & R. Co., which on September 9 cut its New York quotation from 4.80 to 4.70c., a reduction of $4 per ton, put a quietus on price cutting on September 14 by making another and similar reduction, thereby bringing the price down $8 per ton in the course of a week. After the quotation touched 4.50c. independents withdrew from the market, except at the figure of the leading interest, and quiet ensued. Except for some fair-sized sales to Japan there was no business stirring. It is notable that New York now watches London conditions in lead rather than those at St. Louis. Until consumers rid themselves of some of the high-priced lead they bought on the recent rises there is no expectation of any large domestic business. Exports from September 1 to 18, totaled 953 tons.

TIN

Dealers and large consumers are exasperated by the greater restrictions placed by Great Britain on trading in tin, but realize that the English hold the whip hand, and that all they can do is to comply. For days there has been no business worth mentioning, and the spot quotation continues to hover between 33 and 33.62½c. Spot and futures are offered at the same price. The London market has been as dull as that here, largely because no orders were received from the United States. Arrivals for the month up to September 18 totaled 2998 tons, and there was afloat on that day 4210 tons.

COMPANY REPORTS

JUMBO EXTENSION MINING COMPANY

During the past year or so this Goldfield company has attracted considerable interest. The report covers the year ended Jnne 30, 1915. The general superintendent, J. K. Turner, makes the following remarks: The area of the property remains at 97.447 acres of patented claims, including the Velvet of 17.421 acres. Development amounted to 5874 ft., costing $9.89 per foot. Of this, 1354 ft. was done in the Polverde claim. Cross-cuts are under way in a southerly direction at 932 ft. depth. The downward extension of the 524 orebody in the Velvet was 100 ft. south of the Polverde-Velvet side-line, in a raise from the 932-ft. level. A large quantity of ore will be mined from this area. The claim produced 1429 tons of $76.26 shipping ore, and 3284 tons of $15.17 mill ore. Development in the Velvet totaled 4520 ft. A new shale-latite orebody was found near the Polverde-Velvet side-line at 880 ft. depth. The upward extension was proved for 100 ft. and downward is exposed in the raise from 1017 ft. Intermediate-level drifts show continuity between these points. A large tonnage is expected from this area. The shale orebody has been proved from 952 to 1017 ft. Stoping is in progress between the 975 and 964-ft. levels. Both veins lie very flat, an average dip of 27° from the horizontal, this accounting for the short vertical distance between levels. To facilitate general exploration it was decided to enlarge the Velvet shaft, and sink it to 1000 ft. This should be finished by January 1, 1916. The Velvet claim yielded 9049 tons of $74.14 and 2546 tons of $11.14 ore. Ore reserves are estimated at a total of 86,750 tons at $41.21 for shipping and $7 for milling ore.

In June 1914 the Bonnie Claire mill, leased to the company, was closed, and arrangements were made with the Goldfield Consolidated company to treat ore, up to September 10, 1914. The low-grade copper-gold ore is not suitable for the mill, so experiments, mentioned in the PRESS, are being made on this ore. A total of 10,873 tons of dry ore was shipped, valued at $669,560 gross. Tailing and smelter losses amounted to $51,161, leaving $618,399 net value, or, in terms per ton. $61.58, $4.71, and $56.87, respectively. The Consolidated mill treated 5547 tons of ore valued at $81,851 gross, and $32,549 net. The total yield was $650,948, or $39.64 per ton, and net realization $339,373. Two dividends of 5c. each amounted to $125,000; litigation, $11,351; balance of purchase of Velvet claim, $50,000; and settlement of side-line agreement with the Reorganized Booth company, $15,000. The cash balance on June 30, 1915, was $120,533, against $29,100 at the end of the previous year. On September 1 a distribution of 7½c. per share was made, leaving a surplus of $200,000, which is to be maintained.

BROKEN HILL SOUTH SILVER MINING COMPANY

The report of this company covers the half-year ended June 30, 1915. It may be summarized as follows:

Loss of time due to the War affecting sales of lead, days	42
Men employed, average attendance	1,167
Development, feet	3,707
Ore extracted, tons (14.9% Pb, 14.7% Zn, 7.5 oz. Ag)	131,059
Concentrate recovered, tons (61.2% Pb, 9.7% Zn, 22.2 oz. Ag)	24,961
Cost per ton of ore	$4.86
Revenue from production and sale of zinc tailing	$1,378,000
Operating profit	735,000
Amount available, including previous balance	1,858,000
Dividend No. 61	144,000
Metals unsold and concentrates on hand	1,065,000

Development was satisfactory. The mine is 1470 ft. deep.

MINING DECISIONS

MINER'S LIEN—NON-RESPONSIBILITY OF OWNER

An owner of mining property posted, but failed to record a notice of non-responsibility for work and labor performed at the instance and request of an optionee. Persons performing labor on the claim with the full knowledge that the owner would not be responsible and relying solely on the agreement and credit of the optionee are not entitled to a lien for wages.

Street *v.* Hazzard (California), 149 Pacific, 770. April 27, 1915.

OIL LEASE—EFFECT OF ASSIGNMENT

A, owning an oil lease, assigns one-half thereof to B, on condition that B will bear all the expenses of drilling, equipping, and operating the oil-wells to be drilled thereon. B assigns three-fourths of his interest to C on the same condition. C assigns one-eighth of his interest to D "subject to the terms and conditions of the lease from A to B." Held, that D was liable under his assignment for payment of only one-eighth of the development expenses.

Cox *v.* Butts (Oklahoma), 149 Pacific, 1090. June 8, 1915.

CHARACTER OF LAND—EFFECT OF DEFAULT JUDGMENT

While a judgment on default in favor of the mineral claimant in a proceeding between a mineral and an agricultural claimant involving the character of the land in dispute, renders the question as to the character of the land *res judicata* between the parties, it will not be accepted as establishing the character of the land as between the Government and the mineral claimant, and constitutes no bar to further inquiry as to the character of the land involved.

Bailey *v.* Molson Gold Mining Co. (Land Department), 43 Land Decisions, 502. December 16, 1914.

CONVEYANCE OF MINERALS—CONSTRUCTION

Where a conveyance of mineral rights contained the clause, "together with the right to mine said coal and other minerals, the right to use all necessary timber and water for such mining purposes, the right-of-way for all necessary roads, and all other rights and privileges which may be necessary for the proper mining and transportation of said minerals," this clause was held to entitle the grantee to use an air-shaft and fans constructed on the surface and trani-lines underneath the snrface for the purpose of mining coal underneath other lands, in connection with their use for mining coal underneath the lands in question. This rule would not, however, apply to mere lessees of land, or of the surface.

Bagley *v.* Republic Iron & Steel Co. (Alabama), 69 Southern, 17. June 3, 1915.

COAL LEASE—UNAUTHORIZED USE OF PREMISES

A coal lessee covenanted in his lease that he would not nse the premises "for any other purpose than that authorized in this lease, nor allow them to be used for any other purpose." Subsequently the lessee proceeded to sink shafts on the premises from which he extended drifts into the adjacent lands, from which he mined large quantities of coal and removed them through such drifts and shafts. Held, that the lessee should be enjoined from using the leased premises to mine coal beneath other lands, as the lessor would be entitled to no royalties from such coal, and such unauthorized use of the premises would amount to a violation of the covenant above recited.

Sharum *v.* Whitehead Coal Mining Co. (Oklahoma), 223 Federal, 282. April 14, 1915.

BOOK REVIEWS

Properties of Steam and Ammonia. By G. A. Goodenough. P. 108. Charts. John Wiley & Sons, Inc., New York, 1915. For sale by the Mining and Scientific Press. Price, $1.25.

This is a technical study involving thermo-dynamics. Recent investigations on the properties of saturated and superheated steam have resulted in accurate data on the whole subject. Work on ammonia is not so well advanced. The laws governing certain changes in these vapors are explained. There are 74 pages of tables on the properties of steam and ammonia.

Laboratory Work for Coal-Mining Students. By J. Sim and A. M. Wylie. P. 136. Ill., index. Edward Arnold, London, 1915. For sale by the Mining and Scientific Press. Price, 90 cents.

A metal-mining engineer is trained to be able to determine the composition and value of the various ores he meets with; so should the coal-mining engineer be conversant with the mineral he is responsible for extracting. Coal is sold on more exacting terms than formerly, hence the necessity for a thorough knowledge of it. Little has been published on the subject in text-books. The volume under review includes full details of sampling and coal analysis, washing and coking tests on coal, testing of oils, and gas analysis. Chapter V deals with the rather complex subject of fan tests, and the laws of ventilation.

Metallurgical Analysis. Brief course in. By Henry Ziegel. P. 66. The Chemical Publishing Co., Easton, Pennsylvania, 1915. For sale by the Mining and Scientific Press. Price, $1.

This book consists of a collection of standard analyses in daily use in many laboratories. It was written for upper class men, trained in elementary qualitative and quantitative analysis, and who are able to work out problems in chemical arithmetic. Every other page is blank, but ruled for notes on work done. Iron ores, iron and steel; limestones, slags, and clays; non-ferrous alloys; and non-ferrous ores and matte are the main heads of chapters. The methods of analysis are generally rapid.

Transactions of the American Institute of Metals. Vol. VIII. Edited by Charles Vickers. P. 394, and six bulletins. Illustrated. American Institute of Metals, Buffalo, New York, 1915. For sale by the Mining and Scientific Press. Price, $5.

The members of this society devote themselves to the base-metal industry, and in this volume the following subjects are discussed: 'Safety and Sanitation in the Brass Foundry,' 'Progress in the Nomenclature of Alloys,' 'Some Recent Applications of Metallic Cobalt,' 'Drop-Pouring of Casting,' 'Bull Run Talc,' 'Modern Die-Casting Practice,' 'Aluminum Die-Castings,' 'The Care and Conversion of Rolling-Mill Scrap,' 'A Brief Visit to a Brass Rolling-Mill', 'A Hot Shortness Testing Machine for Aluminum Alloys,' 'Making Aluminum Test Specimens on Castings,' 'Failures of Forgible Bars,' 'New Method for the Determination of Zinc in Alloys,' 'Brinell Hardness Testing of Non-Ferrous Alloys,' 'The Commercial Classification of Refined Copper,' 'Spelter-Manufacture and Properties,' 'The Metallurgy of Tin and Antimony,' 'Effects of Repeated Re-Melting of Copper,' 'Tests on Electric Furnaces for Brass Foundries,' 'Electric Furnace for Medium Temperature,' 'Electric Brass Melting,' 'Use of Producer-Gas for Melting Yellow Brass,' 'Pyrometers for Molten Brass and Bronze,' and a report of official chemists of the American Institute of Metals. This list of papers and discussions by members should give an idea of the value of the publication.

The Theory and Practice of Ore Dressing. By Edward S. Wiard. P. 420. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by Mining and Scientific Press. Price $4.

The art of ore-dressing has developed so rapidly and has experienced so many fundamental changes in the last few years that an up-to-date treatise on the subject as applied at metalliferous mines in Western America, written from the standpoint of the author's practical experience as a mill superintendent and designer of mills in various districts of the Western United States and Mexico, makes a timely addition to the technical literature. The author acknowledges the benefit received from personal contact with Professor Richards as a teacher and is appreciative of the immense amount of information contained in Richards' encyclopedic volume. The arrangement of the subject-matter is novel and pleasing. The book makes a good impression from the first and appeals to one as a business-like treatise on Western practice. The many working drawings are a distinct feature; the illustrations are good, clear, and not too greatly reduced in scale. The book will appeal to the mining engineer, to the metallurgist, and to the student. In the hands of an experienced teacher it should be useful as a text-book. What little working theory has been developed to date on ore-dressing is stated briefly but clearly. A single volume of 400 pages necessarily imposes limitations and the author has selected wisely without over-stepping the domain of metallurgy. Amalgamation, therefore, is not mentioned and stamps have received scant consideration. The author is to be complimented on having produced on the whole a fairly well balanced book with an unusual proportion of valuable new information.—C. E. Van B.

History of the Panama Canal, its Construction, and Builders. By Ira E. Bennett. P. XI, 543. Ill., index. Historical Publishing Co., Washington, D. C., 1915. For sale by Mining and Scientific Press. Price, cloth, $5; half leather, $10; full leather, $20.

This book is the product of over three years' labor by the author and his collaborators. Written in Washington, where the men who planned, directed, and built the Canal were always accessible, the History was prepared under exceptionally favorable conditions. The work deals with the history of Panama from earliest days to the completion of the Canal; gives an account of diplomatic and legislative tangles—all the treaties relating to the Canal are contained in the appendix. Among the special contributors are the former chief engineers of the Canal, John F. Wallace and John F. Stevens. Theodore Roosevelt tells how the United States acquired the right to dig the Canal. The justice of his interfering in the quarrel between Colombia and Panama—he simply notified Colombia that it would not be permitted to land troops in Panama—is a subject about which future historians are likely to differ. There is much to interest the engineer in the figures given for the cost of excavating and amount of explosives used, and in the description of the dredges. The Commissary Department and sanitation work is briefly described, and the troubles with the housing of the gold and silver employees is lightly touched. In a recent magazine article, the chief engineer, G. W. Goethals, writes feelingly of the difficulties that he had in adjusting the disputes between the wives of the members of his force; he found the satisfying of these ladies more difficult than the engineering problems of canal construction.

Taking the book as a whole it must be considered as frankly disappointing. The first 13 chapters seem a compilation of historical data from easily accessible sources. No foot-notes, references, or bibliography are given. The publication of the statements of interested parties such as those in Chapters XXXV to XLIX is useful, but critical comment is greatly needed. One map only, and that of no great excellence, is provided. The index seems complete. Pages 322 to 461 are devoted to 'American Industries and the Canal'; much useful information is contained in these pages. If the opinions given

are unbiased they are of extreme utility. But it seems a suspicious circumstance to find, as a rule, only one article of a kind selected for praise. For instance, there seems no special reason why one variety of the multitudinous hosiery that all haberdashers display should be so warmly eulogized; nor, although we are familiar with the article, can we see any superlative quality in the special brand of underwear so highly extolled. These invidious distinctions smell strongly of paid advertising. But when we find in pages 422 to 430 a page and a half devoted to fulsome praise of one brand of cereal, which is mentioned by name 17 times, we feel that the hand of the writers of concealed advertisements has lost its cunning, and we should have been more impressed if the word 'advertisement' had been printed at the bottom of the page. W. H. S.

RECENT PUBLICATIONS

U. S. Geological Survey, Washington, D. C., 1915:

Abstracts from Mineral Resources of the United States, 1914, as follows:

Production of Slate. By A. T. Coons. P. 14.

Production of Asbestos. By J. S. Diller. P. 10.

The Gypsum Industry. By G. F. Loughlin. P. 10.

Production of Mica. By Douglas B. Sterrett. P. 11.

Production of Graphite. By Edson S. Bastin. P. 16.

Recovery of Secondary Metals. By J. P. Dunlop. P. 9.

Production of Asbestos in 1914. By J. S. Diller. P. 10.

Production of Barytes in 1914. By James M. Hill. P. 6.

Production of Phosphate Rock. By W. C. Phalen. P. 16.

Production of Chromic Iron Ore. By J. S. Diller. P. 15.

Production of Talc and Soapstone. By J. S. Diller. P. 7.

Production of Sand and Gravel. By G. F. Loughlin. P. 13.

Production of Mineral Waters. By R. B. Dole. P. 45. Illustrated.

Production of Manganese and Manganiferous Ores. By D. F. Hewett. P. 17.

Gold, Silver, and Copper in Alaska. Mines report. By Alfred H. Brooks. P. 13.

Production of Fluorspar. With a note on cryolite. By Ernest F. Burchard. P. 7.

The Cement Industry in the United States. By Ernest F. Burchard. P. 39. Ill., map.

Production of Barytes. With a note on strontium ore and salts. By James M. Hill. P. 6.

Gold, Silver, Copper, Lead, and Zinc in the Eastern States. Mines report. By J. P. Dunlop. P. 25.

Silver, Copper, Lead, and Zinc in the Central States. Mines report. By B. S. Butler and J. P. Dunlop. P. 98.

Field Apparatus for Determining Ash in Coal. By C. E. Lesher. No. 621-A. P. 12. Illustrated.

Nitrate Deposits in Southern Idaho and Eastern Oregon. By G. R. Mansfield. No. 620-B. P. 26. Illustrated.

The Fauna of the Batesville Sandstone of Northern Arkansas. By George H. Girty. Bulletin 593. P. 170, 10 plates, index.

An Ancient Volcanic Eruption in the Upper Yukon Basin. By Stephen R. Cappo. *Professional Paper* 95-D. P. 6. Illustrated.

Anticlinal Structure in Parts of Cotton and Jefferson Counties, Oklahoma. By Carrol H. Wegemann. Bulletin 602. P. 108. Ill., maps, index.

Analyses of Rocks and Minerals from the Laboratory of the Survey, 1880 to 1914. Tabulated by F. W. Clarke, chief chemist. Bulletin 591. P. 376. Index.

The Duncan Gas Field. Stephens county, Oklahoma. By Carrol H. Wegemann. Bulletin 621-D. P. 50. Plans. Work done in co-operation with the State Geological Survey.

The Loco Gas Field. Stephens and Jefferson counties, Oklahoma. By Carrol H. Wegemann. Bulletin 621-C. P. 42. Plans. Work done in co-operation with the State Geological Survey.

Guidebook of the Western United States. Part D. The Shasta Route and Coast Line. By J. S. Diller and others. Bulletin 614. P. 142. Ill., maps, index. This is the third of the series previously reviewed in the Press.

Geology and Mineral Resources of the National Mining District, Nevada. By Waldemar Lindgren. Bulletin 601. P. 58. Ill., maps, index. This is an interesting discussion, and a résumé will appear in another issue of the Press.

Water-Supply papers:

Ground Water in Big Smoky Valley, Nevada. By O. E. Meinzer. No. 375-D. P. 32. Illustrated.

A Method of Correcting River Discharge for a Changing Stage. By Benjamin E. Jones. No. 375-E. P. 14. Illustrated.

Missouri River Basin. No. 356. P. 291. Ill., index. Prepared in co-operation with the States of Montana and Nebraska.

Ground Water in Paradise Valley, Arizona. By O. E. Meinzer and A. J. Ellis. No. 375-B. P. 25. Ill., maps.

The Relation of Stream Gaging to the Science of Hydraulics. By C. H. Pierce and R. W. Davenport. No. 375-C. P. 8. Illustrated.

Results of Spirit Leveling in Iowa, 1896 to 1913. Bulletin 569. P. 126. Ill., index. Work done in co-operation with the State from 1907 to 1913.

Conditions Requiring the Use of Automatic Gages in Obtaining Records of Stream-Flow. By C. H. Pierce. No. 375-E. P. 9. Illustrated.

U. S. Bureau of Mines, Washington, D. C., 1915:

Composition of the Natural Gas Used in Twenty-Five Cities. By G. A. Burrell and G. G. Oberfell. *Technical Paper* 109. P. 22

Production of Explosives in the United States in 1914. Compiled by Albert H. Fay. *Technical Paper* 107. P. 16. The total was 225,126 short tons.

Monazite, Thorium, and Mesothorium. By Karl L. Kithil. *Technical Paper* 110. *Mineral Technology* 8. P. 32. Plan. An abstract of this appeared in the Press of August 28.

The Buying and Selling of Ores and Metallurgical Products. By Charles H. Fulton. *Technical Paper* 83. P. 42. This is a valuable paper, and an abstract appeared in the Press of September 11.

Gay Gulch and Skookum Meteorite. By R. A. A. Johnston. Museum Bulletin 15. Geological series. P. 31. Ill., 11 plates, map. Department of Mines, Ottawa, Canada, 1915.

Salt Deposits of Canada and the Salt Industry. By L. Heber Cole. P. 160. Ill., maps, index. Department of Mines. Ottawa, Canada, 1915. This should be of interest to salt men in California.

Value of the High-Pressure Steam Test of Portland Cements. By R. J. Wig and H. A. Davis. Bulletin 47. P. 34. Ill. Technologic paper of the Bureau of Standards, Washington, D. C., 1915.

Wind Stresses in the Steel Frames of Office Buildings. By W. M. Wilson and G. A. Maney. Bulletin 80. Engineering Experiment Station of University of Illinois. P. 88. Plans. Urbana, Illinois.

Mineral Resources of Texas. By William B. Phillips. Bulletin 365, scientific series No. 29. P. 362. Ill., index. University of Texas, Austin, 1915. The mineral output of this State is worth over $30,000,000 per year. An abstract will appear in another issue of the Press.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Wood Pipe for Explosion Tests

During the first-aid and mine-rescue contests at the Exposition this week, several coal-mine explosions were shown. For this purpose the Pacific Tank & Pipe Co., of San Francisco, constructed on the Marina a 72 in. fir stave-pipe 110 ft. long, to be used as the coal-dust explosion-gallery. This pipe consists of staves milled of fir lumber, dressed 2¾-in. thick and banded with ⅞-in. bands furnished in two pieces. The lower end of the gallery is banded for 25-lb. pressure; the pressure resulting from these explosions being approximately from 12 to 15 lb., which gradually diminishes to zero at the open end. The bands are spaced farther apart as the open end of the gallery is approached. In the wooden gallery constructed to represent mining conditions, finely divided coal-dust was shown to be explosive. A miners' charge of black blasting-powder was fired from a cannon into the gallery, representing a windy shot. The flame of a charge of this powder is long, hot, and of considerable duration, and gives sufficient heat to fire the dust and start an explosion propagating through the gallery. The U. S. Bureau of Mines wished to demonstrate to visitors at the Exposition the inflammability of certain kinds of coal dust.

Commercial Paragraphs

Bulletins 600 and 1000 of the Pacific Electric Manufacturing Co., San Francisco, deal with high-tension switches, disconnecting switches in the former, and fused isolating links in the latter.

Flotation Oil Circular No. 7 of the Pensacola Tar & Turpentine Co., Gull Point, Florida, discusses its products with frothing and selective qualities. Prices are given for 12 oils, retail or in bulk.

The Mable Mining, Milling & Power Co., Knik, Alaska, has given the Denver Quartz Mill & Crusher Co., of Denver, Colorado, an order for the equipment for a free-milling plant, consisting of one steel crusher, one ore-feeder, one quartz-mill, amalgamating-plates, etc., made by the company.

The Sterling Motor Truck Co., West Allis, Milwaukee, Wisconsin, has published a large illustrated sheet describing its Sternberg dump-trucks. These are made in five sizes namely, 1500 lb., 2, 3, 5, and 7-ton capacity. The Sterling worm-gear drive type, with motor under hood, is made in 1500 lb., 2 and 3-ton sizes.

A novel method for advertising has been adopted by the Charles A. Schieren Co., makers of leather belting, at its exhibit at the Panama-Pacific Exposition. Each visitor to the Company's booth in the Palace of Machinery, Avenue G and Second street, is given a numbered coupon which gives him an opportunity to secure without charge a Keuffel & Esser slide-rule, six of which will be given away on Machinery Day, September 25.

'The Use and Abuse of Ball and Roller Bearings' is the title of a new 20-page paper by F. J. Jarosch, chief engineer of the Bearings Company of America. The text gives explanations and experiences which help in the selection, mounting, and lubrication of ball and roller-bearings in automobile gears and in all other rotating parts, and is intended to help in detecting the real cause of trouble. Nineteen drawings are used to illustrate the text matter. Mr. Jarosch contributes in a practical way valuable ideas on a much discussed subject. Those interested in the subject may obtain a copy free from the publishers, the Joseph Dixon Crucible Company, Jersey City, New Jersey.

Electric furnaces of the Snyder type are being installed by the Thomas Davidson Manufacturing Co. of Montreal, Canada, and the Canadian Brakeshoe Co. at Sherbrooke. High-grade steel is to be made in them. In a paper read before the American Electrochemical Society at San Francisco on September 16, electric steel costs were discussed by F. T. Snyder, of the Snyder Electric Furnace Co., Chicago.

The American Well Works of Aurora, Illinois, has issued Bulletin 141. It describes methods of constructing large capacity deep wells for irrigation pumping in the great plains, an area extending from Nebraska to near the Mexican boundary. The work of the Company's large-size rotary drilling-machine is shown. Logs are given of several wells drilled. In the Palace of Machinery at the Panama-Pacific Exposition this firm has a full line of its apparatus on view.

The medal of honor for self-contained mine-rescue apparatus has been awarded to Siebe, Gorman & Co., Ltd., by the superior jury of the Panama-Pacific Exposition. H. N. Elmer, general agent, 1140 Monadnock Block, Chicago, has appointed E. D. Bullard & Son, 268 Market street, San Francisco, to be his Pacific Coast agents for the sale of Proto, (Fleuss-Davis patents), self-contained oxygen breathing-apparatus and other first-aid and rescue-equipment manufactured by the company.

Bulletins No. 1096, 1412-A, and 1635 of the Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, deal with direct-current motors and generators, types 'K' and 'KC'; crushing-rolls; and the hydro-electric plant of the Cerro de Pasco Mining Co., Peru, respectively. The K motors are designed to meet severe service. The KC is an adjustable speed motor similar in design to the K type. Rolls are being used in larger numbers at mines, and the details of construction are timely. The Cerro de Pasco plant, all of A-C manufacture, consists of three 3750-kva. generators each driven by two 2500-hp. impulse water wheels at an altitude of 12,000 feet.

The Denver Quartz Mill & Crusher Co.'s catalogue No. 12 describes and illustrates its mills, starting with the first one made in 1908. This had seven 300-lb. rolls, weighed a total of 4500 lb., and crushed 10 tons per 24 hours with a consumption of 8 hp. The latest, or No. 3 mill, has four 3200-lb. rolls, weighs 32,000 lb., and crushes 100 tons per day, using 18 hp. A roll-tire from a No. 1 machine crushed hard tungsten ore for six months. It retained its shape even when reduced to 60 lb. from the original 330 lb. Six sizes of steel rock-crushers are made, also a simple ore-feeder of large capacity, and the Kidd placer mining compound riffles.

Continuous counter-current decantation is discussed in Catalogue No. 7 of the Dorr Cyanide Machinery Co., Denver, Colorado. The process consists of operating a series of Dorr continuous thickeners in such a manner that the solids, with a small portion of liquid, pass successively from one thickener to the next, being finally discharged from the last thickener as tailing. The main body of liquid, on the other hand, moves in the opposite direction of the course of the ore and is gradually enriched. By each step of the system a large amount of low-grade solution is mixed with a very small amount of higher-grade solution, so that the value of the solutions entering each successive thickener with the solids is materially reduced. The system is used at the McIntyre, Tonopah Mining, Tough-Oakes, Porcupine-Vipond, Porcupine Crown, Mogul, Tom Reed, Gold Road, Hollinger, and Rochester mills. The last named was described in detail in the Press of August 28.

EDITORIAL

T. A. RICKARD - Editor

PHILIP B. McDONALD has joined the editorial staff of this paper.

THE COST of the War is now estimated at $85,000,000 per day; it will soon be $100,000,000 per day.

ARRANGEMENT of the big loan for the Allies will facilitate dealings in copper and should strengthen the market for that metal.

DIRECTOR of the Mint has purchased 4,375,000 ounces of silver since August 1, or nearly as much as during the whole of last year.

SPEAKING of ore-stealing, as we did last week, it is gratifying to note that a new law in Colorado comes into effect on November 1, whereby every ore-buyer must obtain a license and pay $100 per annum for it. This is intended to check the illicit trade in stolen ore.

FOR the twelve months ending with August the exports from the United States aggregated $3,035,033,280, as against $2,280,185,791 in the previous twelve months. During the same period the excess of exports over imports was $1,365,334,346. Hence imports of gold have increased $184,691,717. These are lordly figures.

ALUMINUM is one of the metals most affected by the War, the price having risen from 17 cents before hostilities began in Europe to 45 cents, at the present time. The output in this country this year is expected to be 50,000 tons, as against 3575 tons in 1900 and 150 pounds in 1885.

ON another page we reproduce the paper presented to the Engineering Congress by Mr. W. R. Ingalls, the editor of the *Engineering and Mining Journal*. It is a pleasure to give our readers this authoritative statement on a subject of such timely interest, for the economics of zinc is one on which Mr. Ingalls is especially qualified to speak.

ACCORDING to a preliminary report by a junior official geologist the Kowkash gold discovery is in Keewatin rocks of a schistose character, traversed by quartz-porphyry dikes. These are normal geologic conditions. Small glassy quartz veins abound, and in one of them a spectacular showing of gold is to be seen. The report does not suggest the addition of a goldfield of any importance to the province of Ontario.

WE TAKE pleasure in publishing part of an address delivered recently before university students by Mr. George Otis Smith, the director of the Geological Survey. It will be found so interesting as to require no explanation for its publication in our pages, but we may confess that one reason for reproducing a large part of this notable utterance is to show our readers what kind of man is directing the scientific activities of the Geological Survey. It is a matter of congratulation that he should be a man of clear insight and wide sympathies, a scholar and a gentleman, as well as a clever geologist and an able executive.

THE miners' strike at Clifton and Morenci, in Arizona, affects 5000 men and stops the production of copper at the rate of 70 million pounds per annum. Apparently it is the purpose of the Western Federation to raise the wages of the Mexican miners on a par with that of the American and other white workers. The companies are willing to treat with the local unions, but they refuse to recognize the Western Federation. That is the main source of trouble.

NEW occasions teach new duties. The War is causing changes so profound in the trade of the world as to require the revision of tariff duties in many countries. Now is the time for a non-party tariff commission. Fresh avenues in trade will be opened; many of the old ones will be closed. Necessity will excite invention to the point of replacing many foreign products with domestic substitutes, in our own country and in others. The world will never be the same as it was before August of last year.

SOME kind friend has sent us a recent issue of the *Cornish Post* in which we find an account of Mr. H. Foster Bain's visit to Falmouth, where he read a paper on 'Prospects for Tin in the United States' before the Royal Cornwall Polytechnic Society. The subject of tin in the United States is much like that of snakes in Ireland, but the smelting of tin concentrate from elsewhere, notably Bolivia, is a live topic, to which Mr. Bain did full justice. He also took part in a notable discussion on 'Cassiterite in Cornish Mill-Products.' This was an explanation and amplification, by Mr. W. H. Trewartha-James, of the painstaking studies made by the late J. J. Beringer, who, as a teacher and metallurgist, had devoted much of his life to the subject. Microscopic examination and elutriation tests proved that the loss of tin on the dressing-floors was due to the escape of "infinitesimally fine particles," beyond the reach of existing methods of wet concentration. As Mr. Trewartha-James suggested, it remains for the Cornish operators either to avoid the making of this elusive slime by altering their crushing apparatus or else to devise a new process. All of which is easier said than done. Those present passed

a resolution advocating the appointment of a commission to investigate the matter. Whether this time-honored way of meeting such a problem will solve it, we may doubt, but we do not doubt the usefulness of Beringer's contribution to technical knowledge. As Aristotle remarked long ago, the first step in any investigation is to ask the right question. In scientific development the first essential is to state the problem. That has been done, thanks to the sustained effort of the tireless worker who has now gone to his long rest, and to the loyal help of his friend. Whatever may happen in tin-dressing, the work of Beringer and Trewartha-James will be associated in honorable memory.

RUMORS of new smelters in the Coeur d'Alene have not been without foundation. We are able to confirm the statement that the Bunker Hill & Sullivan company intends to smelt its own ore. A smelter will be built either at the mine or on the coast, according as an investigation of sites and freight-rates may decide. The product to be treated will be mainly crude lead ore picked from the mill-feed. This ore is practically self-fluxing, only an addition of lime being required. The fuel to be used will be coal either from Utah or Vancouver island. We may add that the mill-products, chiefly concentrate, are under contract at present to the American Smelting & Refining Company, but presumably this part of the Bunker Hill output will go to the new smelter when the existing contract expires. The smelter is to be designed and built by the engineering firm of Bradley, Bruff & Labarthe, of San Francisco. Meanwhile Mr. Harry L. Day, of the Hercules Mining Company, has bought the old smelter at Northport, on the Columbia river, and is now remodeling that plant, having arranged for the refining of his bullion at Pittsburg. These events mark an important departure in the history of the Coeur d'Alene.

SALE of metals by auction is the latest scheme suggested by Mr. W. H. Hughes, the Federal Attorney-General, in order to prevent any coterie from obtaining control of the metals produced within the Australian Commonwealth. His proposal applies particularly to copper, lead, and zinc. The Metal Exchange to be established will be under the direction of the Government. No metals or metallic products are to be permitted to leave the country unless sold under the new regulations. Only members that have been duly registered will be entitled to make purchases. All of which is aimed against the small group of alien metal-merchants who have exercised a not too scrupulous control over the metal markets of Melbourne, London, and Hamburg. The experiment is novel and we shall watch it with keen interest. It is one of those manifestations of State paternalism evoked by the abnormal conditions obtaining during a world-wide war; but like some of the other unexpected results of the Great Unpleasantness, it may have enduring effects. Another episode connected with the Australian metal trade is the dissolution of the contract between the Zinc Corporation and Aron Hirsch & Sohn. This contract, dated August 4, 1914, has been annulled by an English court, for the reason that mere suspension during hostilities rendered it impossible for the plaintiffs to sell their concentrate to persons other than the defendants. However, an appeal has been made, and until that is decided, the Zinc Corporation will not be free. Even then, the company is not likely to erect a smelter of its own in England, where the cost of labor and fuel alike are a deterrent to such an enterprise.

Flotation Patents

We publish a brief review of the application of the physics of flotation to the principal processes patented within the last 30 years. Flotation is not young; in youth it lacked seriousness of purpose, that is all; now it is coming into productive activity. An examination of the brief, and often obscure, wording of the patent claims, followed by the reading of such meagre literature as has appeared amid the smoke of litigation, suggests that the physical principles at the back of the observed facts are not yet understood even by the protagonists of rival claims to the monopoly of the process. At best the progress of flotation has proceeded "by trial and error" or else on a "hit or miss" method to which the adjective 'scientific' is not applicable. That a persistent froth can be produced by several of the schemes of treatment outlined in the various patents is fairly clear, but how much of this desired result is due to the light thrown on the subject by the later operations of the chief patentee is a question that is now within the purview of the courts and will soon be decided by the Court of Last Resort. It is fairly plain that the so-called agitation-froth method as applied at Broken Hill was the outcome of something akin to an accident, by mere ringing of the changes in the quantities of oil, acid, air, and water used in the experiments both in London and Broken Hill; it did not come in the wake of any definite scientific conception of the physical principles involved. That inference is warranted by the evidence given in Court by the group of metallurgists who now claim the privilege of priority. On the other hand, it is only fair to say that while the same or similar results could be obtained by a like variation of older methods of procedure, it is a fact that such results were not obtained—at least, not on a working scale—until aided by recent experience. The controversy over prior rights will be forever confused to the scientific investigator, however the courts of law may decide, because the development of the process as a whole, up to date, has proceeded so largely in the dark, unlighted by a clear conception of the natural laws that govern the metallurgical sequelae. All the claims, protests, and statements as yet supplied to the Patent Office or to the technical press are unconvincing to an unprejudiced student of the subject. Even the Courts—or rather, therefore the Courts—in this and other countries have given decisions so contradictory as to warrant the conclusion that even the legal mind flounders amid the obscure phenomena and the obscurer verbiage of the patentees and their patrons.

Meetings and Discussions

The recent conventions in San Francisco, more particularly the Engineering Congress, have afforded many examples of the failure to elicit oral discussion on technical subjects. The failure, naturally, has not been uniform; in a few cases the conditions have been favorable; this was the case when the session was started by a writer that not only knew his subject and was able to make a clearly written presentation of it, but also had the gift of lucid speech, he being followed by several others likewise well equipped to conduct an interesting debate, under the guidance of an experienced chairman. But such a happy combination was rare. On average, not more than one out of these three desirable conditions was present. On the whole the discussions ranged from a mild success to a complete fiasco. We refer only to the mining and metallurgical sections; how the others may have fared, we do not know. The various factors that militated against success were:

1. An inexperienced chairman.
2. Absence of the authors of papers.
3. Absence of those most competent to discuss them.
4. Oral presentation of an abstract that was either scrappy or a mere repetition of the paper itself.
5. Unwillingness of those present to start a discussion or to take part in it when started.
6. Lack of time to ventilate the subject to any useful purpose when willingness did exist.

As regards the first condition, a chairman ought to control a meeting to the extent of checking aimless talking or persistent verbosity, which wastes the small amount of time actually available. He ought to aid the purpose in hand by recognizing those in the audience that are qualified to speak on the subject, and, if they do not come forward, invite them to do so, in case the discussion threatens to collapse. If an author is absent, it is well to pass his paper, for the attempt then to initiate a discussion is unlikely to be successful; it will have an air of unreality, because one hesitates to criticize opinions when their sponsor is not there to protect them or to make comments to which no reply is forthcoming. That may not always hold good, but it is true sufficiently often to justify a preference for the paper of the man who is present and able to respond on the spot. At the recent Congress, the young men designated as secretaries were told to read selected passages of pamphlets written by absent authors, but as these young men knew little about the subject their reading of scraps failed to summarize the printed matter; it only wasted time. A real abstract or précis of a technical essay requires uncommon skill. Not many authors are able to summarize their own writings off-hand. But the worst case was that of the man who read the whole of his paper, word for word, from a typewritten copy while the audience turned over the pages of the printed copies in their hands. He read it badly, so that if an interval of silence had been set aside those present could have read the paper more comfortably and in less time than the 30 minutes consumed in a gabbled reading of it. Moreover, the paper was not one that lent itself to discussion, and did not elicit any. The chairman did not stop the stupid performance, so that a large part of the session was wasted. At many of the meetings anything from six to eight papers of wide scope were set down to be discussed during two hours. The result was that the author or speaker who had any regard for others coming after him was prone to speak briefly or not at all, while one or two possessed of gab or effrontery could waste a whole morning. The idea of discussing half-a-dozen controversial subjects in a couple of hours is absurd. To present essays, reviews, or compilations of a non-debatable character for discussion is futile; they can be read more comfortably at one's leisure. So much for destructive criticism, now for constructive suggestions, in which we shall be glad to have the help of our readers:

If papers have been printed and circulated previous to the meeting, they should not be read nor even presented in abstract. The time should be devoted wholly to discussion. Those who have not read a paper are not in a position to discuss it intelligently; hence members intending to attend a meeting should take the trouble to read any paper to the discussion of which they expect to contribute or to listen profitably. That would save much time and much aimless comment. Next, the chairman, or the secretary, should see to it that two or three of the leading exponents of the subject are invited or urged to take part in the discussion, so as to give it form and direction. When the discussion has proceeded far enough, in the opinion of the chairman, he should call upon the author to reply. That would be his first participation, except for incidental corrections or answers to questions. Usually only one lively subject can be discussed in two hours. It is much better to discuss one subject effectively than touch upon a dozen ineffectively. There are subjects that are non-controversial, such as statistical information, useful compilations of facts, reviews of progress, and the like; these are suitable for thoughtful writing but not for lively debate; others are essentially controversial, they relate to processes and methods in course of development or pertain to current ideas of timely interest—these are the subjects to be selected, but not without regard to the probability of securing the attendance of those competent to speak on them in a useful and informing manner. We venture to go further, and say that the best kind of technical discussion is likely to ensue when an acknowledged authority, preferably a veteran, gives a short résumé of the existing state of knowledge on a given technical subject, points to the lines of recent development, acknowledges the difficulties it is most urgent to overcome, and, out of the richness of his experience, suggests one or two directions of possible advance. He can say enough to present the chief phases of the subject and in such a way as to invite others to contribute from their stock of experience. A veteran can afford to confess the deficiencies of his knowledge and also to hazard a guess as to the trend of future inventiveness. It is the young and relatively in-

experienced man that attempts an exhaustive review which leaves him and his hearers likewise exhausted. The average essay that is fired at the head of an audience does not invite discussion, it smothers—like Othello's pillow. One or two such experiences, if not fatal, will lead to an abstention from these public meetings and the foregathering of small groups of wiser and sadder men in the antechamber of the lecture-room, in the hotel lobby, or at the club, where they can exchange experiences and ventilate opinions without being bored by the bad reading of printed papers or the jumbled scraps of relentless technology fired at a helpless audience with the rapidity of a machine-gun. The ideal discussion is between three who know their subject; up to a dozen the number is still favorable if the speaking is orderly; but if a large audience is not to waste its time, it is imperative that the proceedings be organized properly. In order to do so, it will be well for members of the profession, more particularly those responsible for the arrangements at public meetings, to give serious thought to the subject and arrive at some system whereby the maximum of benefit may result. As conducted at present, these meetings afford a striking lack of the efficiency that is the ideal of the engineer. They recall the answer given by Talleyrand when, after a long diplomatic conference, he was asked what had transpired. He replied : "Two hours."

Prospectors, Engineers, and Amateurs

Our article on 'The Amateur Miner,' who wanted to get into mining and did not know how, has elicited some interesting discussion. In this issue we publish a good straight letter from one who represents the old-time prospector. For the purpose of argument, it may be granted that we stand somewhere between him and the amateur. In the main, we represent the engineer, that is, the man who applies modern science to the ancient art of mining. However, we have broken bread with the prospector: we have shared his blankets; to us he is a man and a brother. We like to hear from him, and we listen to him with understanding sympathy. Therefore we appreciate Mr. Richardson's protest against the engineer who tries to value a mine with a slide-rule and a tape-line. Have we not protested against the attempt to appraise mines on an investment basis? Mining is fundamentally speculative, and risk is the essence of it. Imagination is needed, and courage. Also some sort of instinct, based partly on inherited qualities, partly on experience, partly on keen powers of observation. That might seem too flattering to Johnny Cone or Pap Brenegan, but it is the complex of aptitudes that made them great seekers and finders of mines, as related by their friend, Mr. Richardson. He says they wandered over the hills "looking *for*, not *forninst*, mines." Presumably the gentleman with the slide-rule represented the *forninst* idea. Probably he did. Mines are not discovered by formula, any more than great men are bred from ordinary babies by an elaboration of scientific nourishment. The tendency to put money into developed mines, thinking thereby to diminish adverse chances, has tended to check the adventurous effort on which mining is nourished. We like the man who would "turn down the Little Tinker cold" on an examination for a client but would be willing to risk his own money on the same prospect. Perhaps that is what is the matter: the decrease in the number of those willing to put their own money into small ventures—the small ventures out of which big enterprises grow. We hear less of the individual operator, like George Hearst, Alvinza Hayward, James B. Haggin, Patsy Clark, Moffat, Delamar, and the like, most of whom made their money out of the ground itself, and not by promoting companies or playing what is called the mining game, that is, selling 10-cent shares to a gullible public. Such 'adventurers,' using the word in its old Elizabethan meaning, have become rare because, among other reasons, the chances for them have diminished. The face of the earth, even the far recesses of the high ranges and the upper limits of the inaccessible creeks, has been surveyed by the topographer and mapped by the geologist. To find virgin territory the explorer must travel north-westward or else choose those tracts over which search has been made for only one or two out of the many metals valuable to man. To succeed he must have not the sophisticated mind of the modern expert, who knows only how to estimate the ore that has been proved, but the optimism that never grows old, mounting to an invincible assurance that the find is not far ahead. That spirit was typified by the old prospector and his burro, by the store-keeper that grubstaked him, and by the assayer that tested his samples as against payment when the lucky strike was made. Yes; we miss that phase of mining; perhaps because we live so much in cities. But somewhere in the hills, in the frontier settlements, the old scenes are still repeated, and the inexpugnable hopefulness of the mineral explorer is in play as in days gone-by. Pap Brenegan's burro is coming down the road laden with a couple of sacks in which is the first fruit of a Chrysolite, a Homestake, or a Treadwell. Reality stifles imagination. We hear so much about the colossal enterprises that we forget how they grew from a fortuitous prospect-hole up the creek and a simple digger in overalls. The adventurous spirit is vanishing like the mist of morning on the high mountains. The unknown retreats, the foreground enlarges. Where once the lone prospector tramped, the long train of gondola-cars laden with ore winds its confident course along the steel highway. The prospector must step aside and take the lonesome trail beyond the reach of the thunderous engines of progress or the whispering wires of civilization. Yet, he ought to be cherished by those controlling the mining industry, not out of sentiment merely but as an essential to the healthy expansion of organized effort. When the millionaires made by mining have finished building libraries, endowing colleges, and running newspapers they might well consider the idea of setting aside a fund for the regular grubstaking of a selected number of real prospectors, the proceeds of their discoveries to go, in part, at least, to the pensioning of worn-out workers in mine and mill.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

The Amateur Miner

The Editor:

Sir—The editorial in your issue of July 24 flags me with a question. You refer therein, as you consistently and insistently do, to the function of the mining engineer as the court of last resort and also first resort on things mining.

I have no quarrel with the mining engineer. But I sometimes wonder if he does not think too much in terms of caution, suspicion, feet, and tons. Become too much *Quod erat demonstrandum*, with the starting promise "It is a risky chance" as it were. Does the attitude not become subconsciously ingrained, like the man who started out to hunt the fellow who ran away with his wife and hoped, by the Great Harry, he wouldn't find him.

Going down on the boat last winter a number of us got to speaking of this phase and among us was a man who might have been your 'Amateur Miner.' He listened to us talk shop and josh about this property and that, which some of us had had the job of inspecting, and finally he said, in effect: "Seriously, I want to ask a question. I know nothing of mining. I have been up to look into some mining business that has happened to come into my hands through the death of the principal owner and my connection with his heirs. The estate is a large one and this matter is comparatively small. Money could be spared to do some work on the property even if it was likely to be lost. I have met the men who are interested in the property, and I have seen the property. My feeling has been that I would advise going ahead. Understand, I do not know anything about a mine, and I have not attempted an examination of the property, though I have been familiar with the developments in connection with it in a business and mining way for upward of two years. I have read assays and descriptions of the working conditions, which seem to be borne out in what I have seen. But the conversation that I have listened to for the last two days, and what seems to be the somewhat cynical attitude of you gentlemen, some of whom at least I take to be mining engineers, has about convinced me that I had better keep to other matters with which I am more familiar. However I want to go a bit further before I drop it. Will you give me the name of a competent engineer to examine this property, whose report and judgment I can rely on. I know men familiar with coal and iron and oil properties. But somehow these Western conditions seem different. Now will you name me a competent engineer?" All the rest but Johnny Casey, Frank Haynes, and myself modestly declined to say "Me!" We three weren't engineers. I presume each one of the crowd thought of some of the other men in the bunch, for there were five or six in the corner of the smoke-room who were competent to pass on a prospect, at least.

Somebody asked "What kind of a property is it and where is it?"

He told us, and a half-dozen names were suggested. Two or three at once gave the name of an engineer who was then in the locality.

A man, engineer and operator, well known to the editors of the PRESS and the oldest in the crowd, said quietly: "I pass. I would not recommend him to examine this property, and some of you know I am an intimate friend of his."

"Why?" came from several of us.

The engineer mentioned, Mr. Blank, was experienced, with a fine technical education and an unusually superior mind, he was keen, honest beyond cavil, and careful to a degree.

"Well, I'll tell you" he said. "One night in the Silver Bow Club we were discussing him and Smith said: "The trouble with Blank is he is inconsistent. He makes all these hard trips, gets skinned up and busted up, and freezes, sweats, and starves, when he might just as well turn down the properties in the office, with his feet cocked up on the desk before he starts. He don't need to go and see 'em. He made examinations for me for two years. He turned down everything he looked at including the ——— in ———, which I would have taken, the ——— and the ——— which would have made me half a million dollars. Give me a hundred thousand tons of ore blocked out, a complex geological situation, a working plant to be figured out and installed, and I know of no superior to him. But he can't see a mine until it is built, so that you can put a slide-rule and a tape-line on it. He lacks imagination. Now Mr. Dash wants to know "Have I possibly got a mine in this property?" And you boys that know him know that Blank will tell him he has *not*. We fellows *here*, can just as well tell him so, as to have him go to the expense of having Blank examine and report on it."

It was pretty drastic. But, knowing the man, I think it was true.

And isn't it more or less your own and my case? I confess I have got it. I start to look at a property and I begin to see possible obstacles and difficulties. I question what the owner is concealing from me, where the nigger in the woodpile is. The hill don't lay according

to my preconceived notions, and the ore occurs differently. They left too many knots on the poles under the bed and the bacon is rancid and I can make better bannacks than those myself, and I can make pretty poor ones when I try, and I wouldn't come down over that bluff in the sleet again for a milliard dollars. And I don't think it is the kind of a property that my client wants anyhow, and I have protected him from a possible bad investment, and my conscience is clear. And were my client to see it, he would probably agree with me.

And then my mind runs back to 'Old Man' Aldrich, Johnny Cone, Otto Abeling, Pap Brenegan—I can see him now with his fat tummy sticking out over the place where the saddle-horn, which he had knocked off with an axe, should have been—Bill Springer on a saddle-horse leading his pack-pony, Jim O'Brien and others, trailing around through the hills looking *for,* not *forninst,* mines. Their work, at least some of them, may have lacked the precision of thought and expression demanded now, and they would have turned a modern flow-sheet upside-down perhaps, to see what the picture was all about. But among them they found properties that eventually made mines. Some big and some small, but which warranted the confidence placed in them by their backers and made and lost them money.

I had occasion the other day to turn in what I like to call "a report." There were more pages of it than there are of this—which is too many. In the accompanying letter I said "For *your* purposes—referring to the characteristics of the addressee—I would make this in about nine lines." Perhaps *you* remember the Gashweiler report. [We do.—Editor.]

Now the kernel in this nut, if there be one, as it refers to the 'Amateur Miner' not wanting to become a minority stockholder in a large company, but wanting to *mine,* is this. In the trend of conditions toward big things, as specially exemplified in a mining way by such properties as Utah Copper, Chuquicamata, Interstate-Callahan, Alaska Gold, with their ability to install refinements of technical operation with resultant economies, are we not altogether losing sight of the opportunities for the sensible placing of money and endeavor in smaller properties, where they will make an adequate return and help to make prosperous little communities, as against big ones? Are we not minimizing the desirability of small undertakings? Are we not perhaps keeping 'Amateur Miner' and a lot of men of courage and enterprise, coupled with only small or moderate means, from mining? They get technicalized and engineered and processed into the Willies, with the idea that mining floats on some kind of a nimbus beyond the reach of common mortals.

The country where you see one and four and a dozen jacks poking down to the railroad once or twice a week or day, with a sack of ore on each side, or the country where an arrastra on the creek, perhaps evolves into a five-stamp mill, where they do pretty bad milling, and there is another one plugging away over the ridge, with fig-trees in the yard by the house, looks just as good to me as does the plant that speaks in terms of thousands of tons, and where, if you are a married man and get a job there you move the Missus and the kids into shack 46, between Ole Halvorsen and his good woman, in 47, and Maguire and Blondie Annie in 45.

Up the creek we've got the Little Tinker. Sometimes six inches, sometimes three feet of *real* ore. Would I ask P. D. & Co. or the A. C. M. Co., or the A. S. & R. to send an engineer to "examine" it? No. But where is Pap Brenegan—peace be—? To blow in out of nowhere and bound anywhere, to stay over-night with you and swap old lies. To go up in the morning and look it over. "Ye should sink from de ind av de drift, an' punch a hole in de hangin! Maybe tis *not* de wall. An' how do you say she runs? She do? Any ixciss of iron? What's your freight an' treatment rates? Goold an' silver values pretty rigular?"

You sit down on the dump and smoke and talk of various things and look at the blue haze gather over the hills across the canyon. "Say," says Pap "I know four or five fellys that have a lease on a block of ground in the Portland at Cripple Creek. Maybe dey would look at yer hole here. An' Mr. Amateur Miner from Bridgeport, Connecticut, I met him on the train goin' in to Salt Lake last fall. He says he has frinds that make brass and money, and he writes me that they will look at a small lay-out. Ye cannot till, maybe 'twill be like Moorphy's wife."

You made a deal. Some time later in boiled four roughnecks from Cripple Creek with steel and powder, tent and grub, and started to shoot the bottom out of the Little Tinker, and the bottom—may be—stayed in, and they are still looking for it. It has proved nothing big, but it has made livings, paid wages, helped develop other prospects, good, bad, and indifferent, and perhaps in the ultimate helped develop initiative, resource, and that dandy stuff—no thin sections have yet been made of it to determine its crystallization or what precedes the 'ite that puts it in the books—that makes the American mountain-man and miner.

Now! As an engineer, if I was one—which I wish I was—I would turn down the Little Tinker *cold* on an examination. But I will put my own precariously earned or stolen money in on it.

The theory? So near as I have it shaped: The engineer comes in properly as a mathematical and scientific factor. Tons, horse-power, formulae, and formations, instruments and 'sich,' a trained mind in a trained body, a follower, a locomotive on a straight track reaching the same place by so much shorter distance and so much less time than the old game-trails did. But there are adventurous summits, and bald descents that he has no place on.

As for Mr. Amateur Miner discussing with one or two engineers of his own social stratum, how would it have been if he had jolted his mental processes by talking to Pap Brenegan, Old Man Aldrich, or Jim O'Brien, men who were looking for prospects and didn't care a tinker if they found one?

Current mining mythology says, especially among the old-timers, "Why, George Hearst could tell a mine as far as he could see it." And I can believe that too. And he could probably tell it *no farther* than he could see it. My recollection of mining fables says he "saw the Homestake." He may have added to keen judgment, a vivid imagination. Taking into account the time, 1877, if I recall properly, and the conditions, not only surrounding the Hills, but the metallurgical and milling knowledge of that day, if it *was* McMasters that recommended its purchase, he must have had a colossal nerve. I wouldn't do it today. Would you? Recalling the conditions? Some 300 miles of Indian country before you reached the tender mercies of the U. P., as I remember the distance.

We want more Hearsts or McMasters, and then not so big. As I have quoted before, Pap Brenegans and gentle Ludwig Sollweins, who would turn a fire-weed out of his road before he stepped on it, and who perhaps did not tell you all he knew about the rarer metals. And pirates like Step-and-a-half Flynn, and Bill Ginschman. The making of the little man and the little property.

Show me from forty to a hundred sore-backed pack-horses a day, and a few ore-wagons, passing my cabin, and I'll show you more human happiness than comes from "breaking her 400 ft. wide," or running a dozen steam-shovels on her. Let the packs keep on traveling and ultimately will come the time that we need the cool judgment, the technical knowledge, and the accuracy of the engineer, to find out whether we have mines or merely prospects.

In the meantime we want the Brenegans, the Flynns, the Amateur Miner—if he hasn't too much money—and perhaps even the MINING PRESS, not forgetting Halloran.

By the way, if any of you know of Ludwig Sollwein's whereabouts, let me know. I have not heard of him for years. CHARLES P. RICHARDSON.

Kitselas, B. C., August 28.

[We refer to this interesting letter in our editorial columns. Of course, we are pleased that Mr. Richardson and his comrades should still want the PRESS and we join with him in "not forgetting Halloran." We are glad to add that, having seen Mr. Joseph F. Halloran recently, we can vouch for his excellent health.—EDITOR.]

Corrections

The Editor:

Sir—Under the head of 'Concentrates' and as space-fillers in odd corners of your magazine a lot of useful matter is to be found, but in collecting matter of this kind errors will, at times, creep in. In your issue of September 4, I find: "Smoke combustion and smoke-burning are not considered good terms in the discussion of furnace-firing. When once made, lamp-black is incombustible and cannot be burned." Anyone who has seen a chimney through which the products of soft-coal combustion escape on fire, or, more correctly, the products of incomplete combustion on fire, will agree that not only is lamp-black combustible but it is capable of producing an intense fire.

Again, as a filler in your issue of September 11, I find: "Combustion may be defined as the chemical union of combustible matter with oxygen, the supporter of combustion." In the early days of chemistry, chemists divided gases into combustible, supporters of combustion, and incombustible or inert; but they have long since given up this classification because the terms are only relative. When, for instance, coal-gas burns in air, as we are apt to say, the oxygen of the air burns and is just as much a part of the combustion as the coal gas. A pretty experiment illustrative of this can be arranged by taking an ordinary lamp-chimney, fitting a cork with two holes, through which glass tubes pass, in the bottom of the chimney, connecting one of the tubes with the coal-gas supply, and leaving the other one open. A piece of fine-mesh copper screening should be placed on the top of the chimney, and the hand placed over this until the chimney is full of gas, then, when the gas begins to flow out of the open tube, it is lighted, the hand removed, and the flame will fly back into the chimney. The surplus gas can be lighted above the copper screen on the top of the chimney, and we have the phenomenon of the oxygen of the air burning in an atmosphere of coal-gas within the chimney and coal-gas burning in air on the top of the chimney. In like manner hydrogen can be made to burn in an atmosphere of chlorine or chlorine in an atmosphere of hydrogen, and so with other gases, so the terms combustible and supporter of combustion as applied to gases being interchangeable should be allowed to die a natural death.

I know the PRESS always welcomes criticism, and, if it does not agree with the critic, is willing to enter into a friendly argument on the subject. I take it, too, that, though you are glad to have errors pointed out on the few occasions that they appear in your magazine, you are sufficiently human to appreciate praise when you know it is sincere, so I venture to congratulate you on the great improvement in the PRESS since you returned to the helm. As it appears today, it is a wonderfully readable magazine, and it is a subtle compliment that a good deal of the matter between the covers is read by the wives of many of the engineers as well as by the engineers themselves.

F. H. MASON.

P. P. I. E., San Francisco, September 20.

CLAY PRODUCTS of the United States in 1914 were valued at $164,986,983, brick and tile being worth $129,588,822, and pottery, $35,398,161. The total was considerably below that of 1913.

ELEVATING PULP at the Tonopah-Belmont mill costs $0.00165 per ton by a 20-in. bucket-elevator, and $0.00175 per ton by a 4-in. solid-lined pump.

IRON ORE shipped down the Great Lakes in August amounted to 8,081,177 tons, against 5,869,477 tons in that month of 1914.

Soroche and Verrugas

A query from a young engineer who was negotiating with regard to a position in Peru and his evident ignorance of the nature and dangers of mountain-sickness, or *soroche*, leads us to think that many other engineers may welcome information on an important, but little discussed, subject. Although our inquirer did not ask about *verrugas*, we mention this disease because it exists along the line of the railway from Valparaiso to Oroya, in Peru in the same region where we first fell a victim to soroche.

Soroche is characterized by headache, nausea, and vomiting, thus resembling sea-sickness; bleeding at the nose is also common; like sea-sickness it does not affect all persons. The cause of it is said to be lack of oxygen in the rarefied air of high altitudes; another theory is that the diminished pressure allows the gases of the body to expand, thus disturbing the relation of the internal organs. The symptoms of the disease are well shown in the following description of an experience on the Valparaiso-Oroya railway:

"The sun shone brightly and the Peruvian passengers were laughing and joking. After reaching an altitude of about 12,000 ft., laughter ceased; with the increasing altitude faces grew paler; by the time we reached 14,000 ft. several passengers, fully overcome by soroche, were vomiting. Near the summit, I left the main line going off on a branch line, whose highest point is practically the same height as Mont Blanc (15,782 ft.), to Yanamina. I had not been ill on the train, but felt depressed when I went to bed; my night was troubled by confused dreams and nausea, finally relieved by vomiting. On the whole, I felt as if I had been sea-sick."

Some travelers do not suffer at all from soroche; others have much more violent attacks than those described above. In rare cases death results. As a rule the sufferer becomes acclimatized within a week or two. But with a change in the weather the disease may return. We heard a Peruvian landlady who had lived at an altitude of 14,500 feet for twenty years say that she still suffered from soroche whenever the weather was unfavorable. Persons who have lived at a high altitude for a long time become ill when they descend to low altitude—a sort of reversed soroche. This malady, caused by the change from a higher to a lower level bears out the theory that the disease is caused by a displacement of the viscera due to a change of pressure. Soroche does not depend on altitude alone for it is certainly much worse at the same altitude on the railway from Valparaiso to Oroya than it is on the railway from Mollendo to Puno. Thus there is a certain mystery about the disease.

But a more mysterious and much more dangerous disease is *verrugas;* this occurs on the same Valparaiso-Oroya railway. It does not exist at Lima, practically sea-level, or at Matucani, 8000 ft., but is found between those places at an altitude of, say, 3000 ft. Verrugas starts with a high fever, followed within a few days by a copious crop of brown warts that may be an inch or more long; death results in the majority of cases. It is said that 75% of a gang of American bridge-builders, engaged in the construction of a viaduct on this railway, died from its effects. The disease attacks a large proportion of all persons who remain in the special locality for more than a few hours. Travelers passing through on the trains are not attacked, but trainmen who pass by daily may fall victims. Quail hunters who go from Lima for a day's shooting, taking their food and water from home, do not always escape the malady. A young doctor who went there for the purpose of studying the disease died before he could record his symptoms.

Our information in regard to verrugas was obtained during a visit to Peru in 1903. Since that date we have often examined medical literature, but have found nothing greatly at variance with the above statement. If any of our readers have later, or more authentic information, we shall gladly publish it. The suddenness of the attack combined with the virulence of this disease makes one think that the old stories relating to the Upas tree may have some other basis than the fact that its sap produces a cutaneous eruption.

Engineers who go to foreign countries will do well to act on the principle that the natives of the country, even though they may be uncivilized, know what is best—especially as regards living conditions and travel. The stranger should follow the customs of the country, unless he is sure that injury will result. This example illustrates the point: A young engineer starting his day's journey from 9000 ft. to ascend to a pass of 16,000 ft. was told that it was best not to eat anything before crossing the pass. But as he did not believe on traveling on an empty stomach, he disregarded the advice and ate a hearty breakfast and luncheon. On reaching the pass he was attacked by a violent colic, from which he suffered agonies. Many strange foreign ways have a sound foundation as had the custom of shutting one's self tightly in a tent at nightfall and not coming out until after daybreak. The reason given by the Peruvians was that the night air was poisonous and brought fevers. Now we explain the fevers by the malarial mosquito.

An engineer should remember that by far the most important duty is to take care of his own health. Health is his capital; moreover, when he loses his health his employers lose his hard-won experience. Hence, we say to engineers: Health first as well as Safety first.

The lode in the Edna May mine, in the Southern Cross district of Western Australia, is a gold-bearing quartz in granite, lying east and west. It is a 'freak vein' as far as that State is concerned, and at variance with the experience of the local mining men. The output totals $1,250,000 from 60,000 tons.

Coal production of the United States in 1914 (final figures) totaled 81,090,631 tons of anthracite valued at $188,181,399, and 422,703,970 tons of bituminous coal and lignite worth $493,309,244, a total decrease of 56,434,742 tons.

The Economics of the Metallurgy of Zinc

By WALTER RENTON INGALLS

*Even before the war began, the zinc industry of the world was experiencing radical changes. The effect of the war will be to produce more changes, whereof no man can yet clearly foresee the nature and scope. Looking backward, we can now perceive that 1896, when the Wilfley table was introduced, was an historic date in the metallurgy of zinc. Making possible an improved concentration of mixed ores requiring fine grinding, the first step in the solution of the long-baffling mixed ore problem had been taken and the smelters were offered a new and bountiful supply of lead-bearing zinc ore, often high in iron, to which they had to adjust their metallurgy. Another important step in the separation of mixed ores occurred subsequently with the introduction of Wetherill's system of magnetic separation and Blake's system of electrostatic separation, but the climax occurred with the successful introduction of the flotation process at Broken Hill.

The development at Broken Hill had at least three great consequences, namely, it standardized smelting practice in Belgium and Germany; it compelled nearly all of the smelters of those countries to go on a zinc-lead basis; it showed that mixed ores could be profitably treated, and caused a search for them to be made in all parts of the world, which within a few years resulted in the development of such mines as the Butte & Superior, of Butte, Montana, the Bawdwin, of Burma, and the Ridder, of Siberia, to mention only three of the first order.

Let me be more explicit respecting the above statements. The total zinc production of the world, in 1913, was about 1,000,000 metric tons, of which Belgium, Holland and Germany produced about 500,000 tons. Broken Hill, in 1910-'12, produced an average of 450,000 tons of blende concentrate per annum, averaging 46 to 47% zinc, which may be roughly calculated as equivalent to a yield of 170,000 tons of spelter, or about 35% of Germany and the Low Countries.

The immense Australian ore-supply was contracted to the three great German metal-merchandizing firms, which distributed the ore among the smelters of Germany and Belgium. Those smelters coming thus into possession of so large, so uniform, and so regular a supply of ore, the like of which in none of those respects had ever previously been experienced in the zinc industry, were able to standardize their smelting practice, not only as to a single works but also as to many works; which was metallurgically beneficial.

The Broken Hill zinc ore was rather high in metal. In previous times, zinc smelters generally were averse to smelting ore containing more than 2 or 3% lead, although there were a few smelters who made a practice of treating ores relatively high in lead and recovering a considerable proportion of the lead therefrom. With the advent of the Broken Hill ore, the recovery of lead as a by-product in zinc smelting became the regular thing; and in fact, the smelters of Belgium and Germany went practically upon a zinc-lead basis and even became insistent upon having a percentage of lead present in their ore, that was far above what in earlier years had been regarded as permissible.

Another radical change in the zinc industry, that was in progress previous to the war, involved the establishment of new *loci* of zinc smelting and was rather directly connected with the Australian development. The art of zinc smelting is one of a multiplicity of details in which the part played by many workmen spells the difference between success and failure. No matter how careful the plans of the engineer may be, they are likely to come to naught unless there be good workmen to carry them out; and the making of good workmen requires long training. The possession of a class of workmen which has been engaged in zinc smelting during several generations, is one reason why Belgium continued to be a great zinc-smelting country long after its own resources were exhausted. And because of the absence of such a class of smelters, it has been universally the experience that the inauguration of new zinc-smelting enterprises in new regions has been attended by difficulties which generally have wrecked the adventurer. With the advent of the great Australian ore-producing interest, however, there entered into the zinc industry a group of concerns with financial resources that enabled them to build zinc-smelting works in any logical location, and, with equanimity, to carry them through the period in which the native population had to be taught how to smelt zinc ore. Thus, we have already witnessed the erection and operation of two zinc smelteries in Australia; we have seen the foundations laid for a great zinc smeltery far away in Siberia; and we have reason to believe that ere long a zinc smeltery may be erected at some seaport of India. In the meanwhile, the Japanese, with their customary adaptiveness, have inaugurated zinc smelting within their empire. There were, therefore, plans on foot that promised to make the art of zinc smelting one of far wider application than it had ever been during the century of its commercial history. These conditions were fully in evidence before the War began.

Germany, by virtue of its own great deposits of zinc ore in Upper Silesia and its contracts for the Broken

*A paper presented before the International Engineering Congress, 1915, in San Francisco.

Hill ore, was the great purveyor of spelter to the rest of Europe, especially to England. The first great consequences of the war were to suspend, to a major extent, the production of zinc ore in Australia, there being insufficient surplus smelting capacity outside of Germany and Belgium to receive it; and to throw a large part of the spelter requirements of Great Britain, France and Russia upon the United States, the result of which was to raise the price of spelter to a figure not previously recorded in many years. What other major and minor effects the disturbance of the war may have upon the spelter industry lie within the sphere of prophecy. I will venture no more than the suggestion that they will be profound.

The world's great districts of zinc smelting have heretofore been Upper Silesia and Rheinland-Westphalia, in Germany; the valley of the Meuse and the Campine, in Belgium and Holland; Kansas, Oklahoma, and Illinois, in the United States. The art of zinc smelting was first introduced (from China) into Great Britain, but the British smelters have not, during the last 100 years, been leaders in the art; nor has zinc smelting attained great magnitude in their land.

During the last 50 years, there have been three types of zinc smelting (the earlier English and Carinthian processes having disappeared), which are known as the Silesian, Belgo-Silesian, and Belgian. In recent years, the Belgo-Silesian method has become known as the Rhenish, and this has shown a strong tendency to displace the Belgian process in Belgium and an even stronger tendency to displace the Silesian process in Silesia. The reasons for this are discussed in the metallurgical treatises, of which zinc smelting has recently acquired a rich literature. They may be summarized as a superior economy, as compared with the Belgian furnace; and, in Silesia, a change in the character of the ore which causes this method to be better adapted than the Silesian furnace. In the United States, the method of smelting is essentially the Belgian, which has been modified to conform to peculiar conditions.

Considering the art of zinc smelting upon its broadest lines, the variations between European and American practice are explained by variations in fundamental conditions, which may be summarized in the statement that in Europe labor is cheap and coal is dear; while in the United States, coal is cheap and labor dear. Thus, we find American smelters striving ever for mechanical substitutes for hand labor, and European smelters aiming always to reduce coal consumption. There have been other determinative factors, the differences between which are, however, tending to disappear. One of these is permanence of the smelting districts. Another is scientific attention to the art.

Zinc smelting was begun in Upper Silesia in 1798 and on the Meuse in 1807, and ever since those dates, has been conducted in those districts. Their metallurgical stability has induced operators to build substantially. From an early date, moreover, the smelting was directed by educated metallurgists, and both in French and German is there a literature extending backward for a century. In the United States, on the other hand, only two works, namely, those at LaSalle and Peru, in Illinois, have a long history, and, in the main, the zinc smelting industry has been characterized by shifts and uncertainties that stifled ideas of permanent building. About 1871, zinc smelting was begun at Pittsburg, Kan., and for 30 years was conducted with an absurd disregard of scientific control. Not until about 1898 were chemists employed, even to assay the ores bought and smelted. Ore was cheap, and for three decades the precept was "better butcher the ore than butcher the furnace." About 1901, most of the smelteries in this district were scrapped and the Iola district, where natural gas occurred, became paramount. Ten years later, Iola was the scene of deserted works and the star of Bartlesville and Collinsville, in Oklahoma, was ascendant, but even now it is waning and the great locus of zinc smelting is becoming the coalfields of Illinois and farther eastward. With this last move, zinc smelters show that they are building for permanent business, not merely to reap some ephemeral natural advantage, and with the utilization of the services of metallurgists (which has been general only within the last 10 or 15 years), certain differences between European and American results are tending to disappear.

One other basic condition requires mention. European smelters operate generally in highly developed industrial regions, affording a market for sulphuric acid and rendering the free discharge of sulphur smoke unpermissible anyhow. Therefore, European smelters long ago began to make sulphuric acid as a by-product of blende roasting. American smelters, on the other hand, were able to emit their smoke without doing great harm and had no market for acid. Consequently, they did not make it. This condition, also, is undergoing radical change. Every smelter of blende east of the Mississippi river now makes acid.

In many respects, the development of the American zinc smelting industry has exhibited absence of initiative and curious contradictions. Our two great names are Wetherill and Hegeler. The former invented the process of making zinc oxide direct from ore. The latter introduced the first successful mechanically-raked muffle furnace for roasting blende, modified the Belgian distillation-furnace and introduced many mechanical contrivances. The best American zinc-smelting practice of the present day follows very closely in Hegeler's footsteps, with certain improvements borrowed from Belgium and Germany.

During the last 20 years, the vogue of the mechanical furnace for blende-roasting, in the United States, has become all but universal. At the present time our works have capacity for roasting about 800,000 tons of blende per annum, and only two or three examples of the old hand-roasting kilns survive. Yet, of our mechanical furnaces, the Hegeler dates back to 1884, and during the last 15 years there has been no introduction of any new type—an emphatic commentary upon the absence of

originality that has, heretofore, characterized zinc smelting in America. In the meanwhile, the Germans have exhibited much alertness in developing and adopting mechanical roasting furnaces in spite of their lower rates of wages and consequent lack of incentive to substitute machines for men.

I may best elucidate further comparisons between European and American practice by sketching the principal parts of a modern zinc-smelting works. In all of what follows in this paper, I have in mind only the smelting with coal-fired furnaces, dismissing from attention the smelting with natural gas in the United States, which is on the wane. Nor are the figures that I give intended to represent the practice with Silesian furnaces in Upper Silesia, Germany.

The ore is delivered into the works in railway cars, from which it is unloaded directly into the storage-bins. The means for unloading, sampling, storing, and reclaiming have, heretofore, been rather crude in many of the American works, but recently there has been an increasing tendency to adopt the superior methods that have long obtained among lead and copper smelters.

The ores coming to the zinc smelter are classified as calamine and blende. In Europe, the former is still calcined. In America, the calcination of calamine was abandoned by the smelters many years ago, the advantages being pronounced unequal to the cost. Blende, of course, must always be roasted. In America, we use the Hegeler furnace if sulphuric acid is to be made; otherwise, simpler forms, of mechanical furnace. Our object is mainly to save labor. In Europe, hand-raked furnaces of the Rhenania, or the later Delplace, type are commonly employed, which are both designed and operated to save coal. The dead-roasting of blende has been regularly effected with a coal consumption of only 10% of the weight of the ore, a lower figure than has ever been achieved in the United States. However, there is a growing usage of mechanical roasting furnaces in Europe and an adoption of such new and excellent types as the Merton and the Spirlet, which American smelters have not yet ventured to try.

The roasted ore goes to the mixer, where it is united with the proper proportion of reduction coal. Mechanical mixing and careful attention to this important part of the process were early practised at LaSalle, but, elsewhere in the United States, this was generally done in ways far below European standards until recently. However, we are no longer subject to such a reproach.

Following European practice, our distillation furnaces are now commonly built entirely above the ground, the unclean, uncomfortable and unsanitary subterranean galleries of old being abolished. The Europeans are still ahead of us, however, in ventilation of the furnace houses. The Europeans generally lay out their furnaces in line. We lay them out in rows. The Europeans commonly employ recuperative (both reversing and countercurrent) furnaces—again with view to economy of coal—and succeed in smelting a ton of ore with as little as a ton of coal. In the United States, we use mostly the long Hegeler furnace. With natural gas firing, there is no heat recuperation. With coal firing, the economizing of fuel takes the form of generating steam from the waste gases. The long furnaces and the steam boiler accessories are distinctly American, and both are due to Hegeler. To Hegeler also is due the charging car, metal drawing car, and other mechanical contrivances in aid of the work about the distillation furnaces. The only successful mechanical chargers, however, are of European origin; but a recent American invention of some promise is a mechanical discharger. A distinctive feature of American distillation furnace practice is the use of blowers for the delivery of the combustion-air to the furnaces.

In the manufacture of retorts, the hydraulic press, which originated in Belgium, is now commonly employed both in Europe and America. However, the Europeans give more attention to the manufacture of their retorts and, unquestionably, make a better retort than we do.

In the handling of material in the works, the modern American plants are as well equipped with tramways, elevators, etc., as are lead smelteries of corresponding size. In this respect, our best American plants are in no wise inferior to the best European.

European smelters have long recovered lead and silver from their retort residues. American smelters now do so to a considerable extent, but the treatment of lead-bearing ores and recovery of the lead is less a feature of American practice than it is of the European. American zinc smelters pass the whole of their residue to the lead smelters. European zinc smelters concentrate it by jigs and tables and deliver a lead concentrate for smelting.

Metallurgically, the essence of zinc smelting is the temperature of distillation. Speaking generally, the higher the temperature the better is the extraction of zinc. But with bad ores, and bad practice, high temperature is indefeasible; for the furnaces and retorts will not stand it. A bad ore may be smelted with but little trouble, at a relatively low temperature, but the extraction of zinc will be poor. The aim of the zinc smelter is to melt a bad ore and obtain the maximum possible percentage of zinc out of it.

In general, the Europeans excel the Americans in this respect. They mix their ores scientifically, they make better retorts and they build stronger furnaces, all of which contribute to an ability to drive their furnaces at higher temperature than Americans have yet attained, and, at the same time, they manage with ores that are rather high in lead. In so smelting, they make a leady spelter, but a simple refining in a reverberatory furnace removes the excess lead. In only one American works is that practised.

European smelters also generally recover 'blue powder' as a commercial product. This is obtained from the 'prolongs,' which condense a proportion of zinc that would otherwise be lost. American smelters do not use prolongs. Although in trials of them, an additional 1 or 2% of the zinc has been obtained, they have found it to be unprofitable—this again reflecting the difference in labor conditions.

I have outlined the main differences between European and American practice in zinc smelting. They are explained by the reasons previously mentioned. Per ton of raw sulphide ore, the American smelter uses about 2 to 2½ tons of coal and two or three man-days of labor; and extracts about 84 to 88% of the zinc that is in his ore; if he treats lead-bearing ore, he may recover 50 to 60% of the lead.

The European smelter uses about 1¼ to 1¾ tons of coal and 3 to 3½ man-days of labor; and extracts 88 to 90% of the zinc that is in his ore, and about 50 to 70% of the lead.

I hope to disarm criticism of these figures by stating that such figures properly should be accompanied by qualifications and explanations that would run to pages in length and would constitute a condensed treatise upon the metallurgy of zinc; and that I offer the figures that I have used merely as broad generalizations for the purpose of exhibiting, in tabloid form, the lessons deduced from the differences in the art as practised in Germany and the Low Countries and in the United States. They mean that the Europeans, with the aid of better furnaces and superior technical direction, are able to smelt more refractory ore than we Americans, and yet extract a higher proportion of the valuable metals. They have built more substantial plants—secure from fear of geographical migration of their industry—for the sake of increased durability and maximum economy of fuel. While the rates of wages are higher in the United States than in Europe, American zinc smelters have not been able to offset that by the development of superior efficiency, in the ways that the copper and lead smelters have done. Man for man, the German and Belgian smelter does as much work as the American. Thus, the attendance of the distillation furnaces in Rheinland and Belgium requires 1.75 to 2.5 man-shifts per ton of roasted ore, while in America the requirement is 1.75 to 2.25. The difference in labor in roasting is insignificant when mechanical furnaces are employed. Such economies in labor as America has effected have been chiefly in the handling of material, which, in zinc smelting, is a relatively small part of the process.

Before concluding this paper, I am bound to refer to certain misconceptions respecting the status of zinc smelting that continue to exist and the possibilities of any radical changes happening in this art, such as have happened in lead and copper smelting.

The art of zinc smelting is far from being at a standstill. When we find 1000 kg. of ore requiring 1000 calories of heat being distilled with 1100 kg. of coal equivalent to 8000 calories, as is done in the best practice, we are observing a thermal efficiency of 12½%, which compares favorably with good steam practice. When we find a ton of ore being smelted with 2½ man-days of labor, and consider that we are dealing with a concentrated product, and reflect that the total weight of material handled is relatively small and that the work on it from step to step is often more cheaply done by a man than by a machine, we do not feel unduly mortified by our results. Nor does the extraction of only 85 or 90% of the zinc content of the ore shame us very much when we reflect upon the peculiar and troublesome metallurgical properties of zinc.

The so-called problem of the mixed sulphide ores that has engaged so much attention during 50 or 60 years, is not a question of how such ores may be treated—for means have been known for a long time—but, rather, is it a question of how may such ores be treated with sufficient cheapness. This problem has been solved to a large extent by the improvements in the art of mechanical concentration (especially the flotation process) and the improved ability of the zinc smelter to treat plumbiferous and ferruginous ore. Yet, there are still ores whereof the beneficiation is highly unsatisfactory, such, for example, as those ores which contain fluorite and those ores which are a crypto-crystalline mixture of the component sulphide minerals. The present treatment of zinc ores that are high in silver leaves much to be desired. For some of these ores it is possible that hydrometallurgical, or hydrometallurgical-electrometallurgical processes, may be useful in certain cases. There has been a commercial hydrometallurgy of zinc for many years, but it has not been extensive, simply for the reason that most ores could be more profitably treated in other ways. The precipitation of zinc from solutions by electrolysis used to be troublesome and unsatisfactory, but now that seems to have been mastered.

Electric zinc smelting, which has engaged a good deal of attention during the last 15 years, is metallurgically of the same nature as ordinary smelting: the main difference is that, in one case, the zinc is distilled by the heat of the electric arc or the heat of electric resistance; while, in the other case, it is done by the combustion of coal. So far, electric smelting has become an art only in Sweden and Norway, where several thousands of tons of spelter are annually produced by this method. The smelters in Sweden and Norway enjoy very cheap power, whereby they have been able to overcome, or at least meet, the main obstacle that has heretofore prevented electric smelting from becoming a commercial art elsewhere.

EXTRACTION of gold and silver at the Tonopah-Belmont mill is the following in each department: in stamp-battery, 34.4% Au, 5.3% Ag; in tube-mills, 40.7% Au, 10.28% Ag; concentration, 6% Au, 9% Ag; in lower thickeners, 3.1% Au, 9.33% Ag; in first six agitators, 9.4% Au, 50.99% Ag; in upper thickeners, 1.2% Au, 2.0% Ag; in second six agitators, 0.3% Au, 4.3% Ag; and in stock-tank and filters, 1.25% Au, 1.56% Ag, a total of 96.35% and 92.76%, respectively.

A 155-OZ. GOLD NUGGET was found at Ora Banda, 40 miles from Kalgoorlie, Western Australia, in July. Others found in that State since 1888 are as follows: 127, 100, 480, 298, 333, 463, 487, 372, 168, 197, 168, 109, 51, 230, and 180 oz., respectively. Many of these were found in dry-washing.

What is Flotation?—II

By T. A. RICKARD

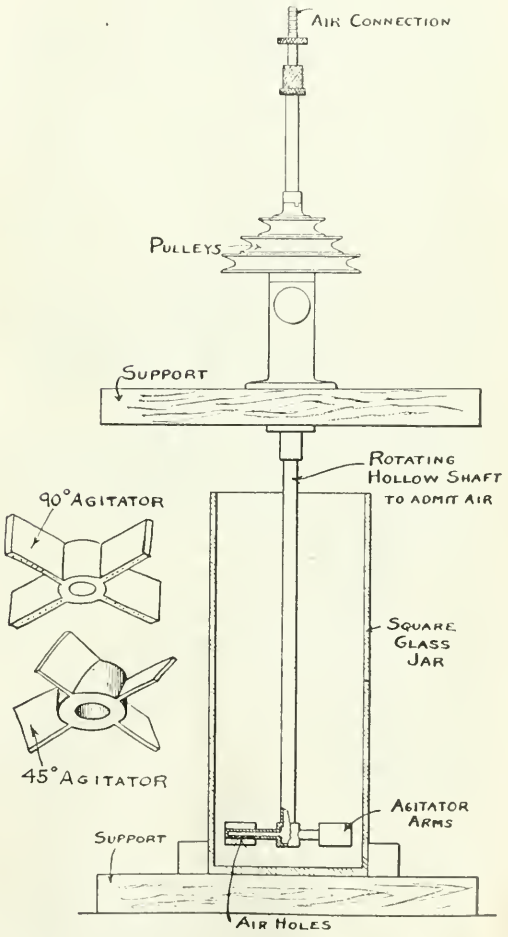
All of the natural phenomena, or appearances, described at the beginning of the previous article, play their part in flotation and each of them has served as the basis for one or other of the many patents that have involved the subject in a maze of vindictive litigation.

Surface tension is the idea underlying Hezekiah Bradford's patent of 1886. In this process the dry powdered ore is caused to meet the surface of a still body of water, so that the metallic particles, which are not wetted, are made to float away, while the gangue particles, which are wetted, sink. This was the first application of flotation without the aid of oil.

In 1904 A. P. S. Macquisten invented a tube apparatus in which surface tension is utilized for concentration. In 1906 the process was applied on a working scale in the Adelaide plant at Golconda, Nevada, where chalcopyrite was separated from a lime-garnet gangue. In 1911 the Federal Mining & Smelting Co. adopted the process for the Morning mill, at Mullan, Idaho, in the separation of blende and galena from a quartz-siderite gangue. At Golconda 96 tubes treated 125 tons per day; at Mullan, 119 tubes treat 150 tons. The iron tube is 6 ft. long by 12 in. diameter. The interior is cast with a helical groove. The tube is revolved at 30 r.p.m. Success appears to depend upon the angle at which the metallic particles are presented to the surface of the water. Subsequently, the water at Golconda was slightly acidified, so that it must have caused an ebullition of carbonic acid gas from the lime in the ore. Thus the bubble phenomenon may have come into play. Later, small additions of coal-oil were made, so that another phase of flotation was introduced. In the first instance, however, the Macquisten tube was a real surface-tension process.

In 1905 H. L. Sulman and H. F. K. Picard obtained a British patent for a similar process, but it was a failure. As the floating particles are in the nature of a film, or "in patches one particle thick," the area of the separating surface has to be large and still. Moreover, some gangue-minerals are floated as readily as the metallic parts of the ore.

In 1912 H. E. Wood described his method of concentration, by the surface tension of water alone, in a paper read before the American Institute of Mining Engineers. In common with other metallurgists, he had noticed that dry particles of sulphide minerals are "good swimmers." In all gravity work, we try to drown them. He had also proved for himself that the oxides are easily wetted. Thereupon he devised a machine in which the dry-crushed ore is fed in a thin stream from a vibrating plate onto a current of water. An impetus is given to the surface by small water-jets. By retarding the current the gangue is made to sink, while the film of sulphides remains on the surface. The elasticity and tenacity of this film is remarkable. The process is being applied on a commercial scale to molybdenite ores by the inventor, Mr. Wood, at Denver. He has also made experimental demonstrations on graphite, tellurides, and other lustrous minerals. At the San Francisco del Oro mill, in Chihuahua, Mexico, 12 of his machines are in use on an ore that has defied other efforts at concentration.



THE SQUARE GLASS JAR MACHINE FOR MAKING FLOTATION TESTS.

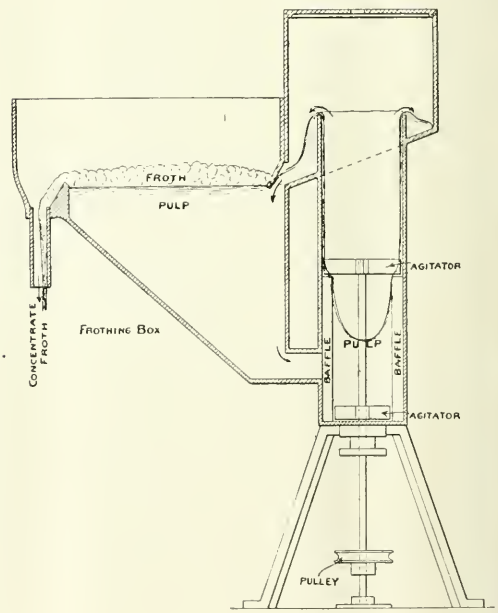
Bulk-oil flotation was invented by Robson & Crowder in 1894 and developed successfully by Francis E. Elmore, whose British patent was obtained in 1898. In the Elmore process the crushed ore is mixed with several times its weight of water. With this pulp a weight of oil equal to, if not exceeding, that of the ore, is mixed gently, so as not to break or emulsify the oil. The oiled mass is run into a spitzkasten, where the oil rises to the surface, buoying the metallic particles, while the gangue and water are removed at the bottom. While oil is described as the prime agent, it is probable that air, entrained by agitation, increased the buoyancy of the concentrate.[1]

Oil and Air. Coming to processes using a combination of oil and air, we have the Everson patent of 1885. Carrie J. Everson was washing some sacks in which concentrate had been shipped to her brother's assay-office at Denver when she noticed that the sulphide particles floated on the water. It is said that the sacks had become greasy, but it is quite likely that she used soap, in which case the greasiness is not required as an explanation. In her process the maximum addition of oil, namely, 18%, is less than one-sixteenth of the quantity required for bulk flotation. As to air, that she obtained by the agitation of the pulp by means of two fans radiating from a hollow revolving tube. The result—according to a description written in 1890, not in the light of prejudiced observation today—was the formation of a "thick scum of sulphides" that "rose to the surface and was skimmed off, leaving the hitherto black ore as white as snow."

The original bulk-oil process of Elmore had numerous applications, some of which were fairly successful, but in 1904 it was displaced by the Elmore vacuum process, in which flotation by bulk-oil was subordinated to the buoyant effect of air-bubbles generated from the oiled mixture while under a vacuum, and by heating. Under normal conditions water holds in solution an amount of air equal to 2.2% of its volume. This is liberated under a vacuum, but neither the amount of air released (especially at high altitudes) nor the quantity of oil used suffice to explain the degree of flotation achieved, as measured in weight of concentrate. The presence or the addition of limestone or other carbonates, with the use of acid, suggests the aid of bubbles of gas other than air. The proportion of oil in this process has been decreased gradually from 10 lb. per ton of ore to as little as 2.7 lb. per ton. As the mixing involves violent agitation, it seems inevitable that entrained air plays a part.

To the 'oil and air' process we must add that of Edmund B. Kirby, for which patent was applied in December 1903 and granted in January 1906. Kirby experimented on ore from Rossland, British Columbia. He used a large proportion ("one-fourth to three-fourths as much, by weight, as ore") of oil; he added acid; he employed heat; he "thoroughly agitated"; he "injected air into the mass"; and he obtained "a floating scum of hydrocarbon liquid, air, bubbles, and concentrates." In the light of later events it is claimed that he must have made a 'froth,' because the oil was insufficient to cause bulk flotation and the agitation sufficed to entrain enough air to produce a froth. To this the patentees of the so-called 'agitation-froth' process reply that his "scum" was not a "froth" in *their* sense of the term. That he produced froth seems highly probable; but to say that 'scum' and 'froth' are the same thing, is, in my opinion, not correct.[2]

Bubbles. Meanwhile the bubble methods of Charles V. Potter and Guillaume D. Delprat had been patented



THE JANNEY FLOTATION MACHINE.

in 1902. In these processes gas was chemically generated with a view to promoting the flotation of metallic particles in Broken Hill ore. This Australian ore contains calcite, which by the addition of acid, emits bubbles of gas that adhere to the sulphides. Potter used acid, agitation, and heat, while Delprat employed a hot solution of salt-cake or acid sodium sulphate and sulphuric acid. Both processes were successful on a large scale, particularly Delprat's, which is still in use at the Broken Hill Proprietary mine. Neither used any oil. The bubbles attach themselves to the sulphide (blende and galena) particles and carry them to the surface,

[1] A suggestion that is confirmed by the statement of Walter McDermott that "in practice [of the Elmore process] the agitation with the pulp results in the oil taking up a very appreciable quantity of air, giving a certain sponginess, with natural increase in floating power." 'The Concentration of Ores by Oil.' *E. & M. J.*, February 14, 1903, page 262.

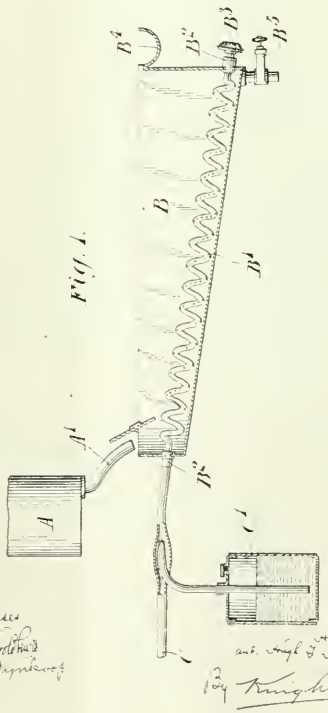
[2] 'Scum' is the impurity or extraneous matter that rises to the surface of a liquid, such as the vegetal film on a stagnant pond or the dross on a bath of molten lead. 'Froth' is a multiplicity of bubbles.

whence they flow with the liquor into a compartment where, the bubbles breaking, the metallic freight is dropped, and collected as a mixed concentrate. T. J. Hoover says[3] that "the result of the manipulation to which the material is subjected is the formation of a dense froth of bubbles and mineral"; but this was published in 1912, and must be read in the light of events long subsequent to the claims made by either Potter or Delprat. In order to explain the making of froth without oil, he suggests the presence in the ore of such substances as "yield gummy organic compounds that selectively adhere to the ore." This is an important suggestion. Be that as it may, the Potter and Delprat methods demonstrate that flotation is practicable by the aid of bubbles without the addition of oil.

In the Froment process, patented in Great Britain and Italy in June 1902, the bubble idea is dominant, for, while Alcide Froment used oil, he employed it to attract the bubbles of gas generated by the reaction between acid and calcite, adding the latter if suitable carbonates were lacking in the ore. He emphasized the fact that not only have the lustrous metallic particles an affinity for films of oil, but the oil itself attracts bubbles of gas, both air and carbon dioxide. He recommends much less oil than had hitherto been used, namely, "a thin layer of oil," which has been interpreted, according to the exigencies of litigation, to mean anything from less than 1% up to 14%, according as the Froment patent was being upheld or attacked. In Froment's later instructions to the purchasers (Minerals Separation Ltd.) of his patent he mentioned the quantity as from 1 to 3½%. For a 5% sulphide ore, the oil would weigh 20 lb. per ton. This question of the quantity of oil required by Froment has been much discussed, but the dominant idea in his mind appears to have been the affinity of oiled particles, necessarily sulphides or lustrous metallic particles, for bubbles of gas. These he obtained by agitation (air-bubbles) and by adding both acid and calcite (bubbles of carbonic acid gas) to the pulp. As to what "a thin layer of oil" may mean, I do not know what Froment meant by the expression, but the scientific meaning of the phrase is indicated by the fact that oil when dropped on the surface of water will spread out in a film one molecule thick.[4]

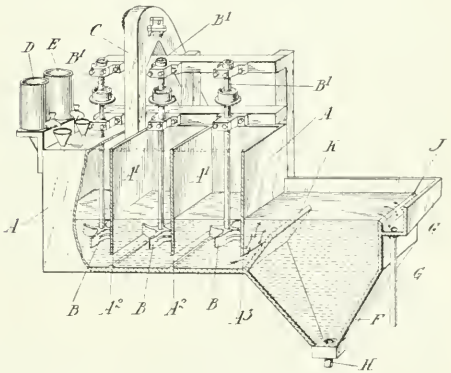
[3] 'Concentrating Ores by Flotation.' Second Edition. Page 101.

No. 793,808 PATENTED JULY 4, 1905.
H. L. SULMAN & H. F. KIRKPATRICK-PICARD.
ORE CONCENTRATION.
APPLICATION FILED OCT 5, 1903
3 SHEETS SHEET 1



Witnesses
Inventors

H. L. SULMAN, H. H. GREENWAY & A. H. HIGGINS.
ORE CONCENTRATION.
APPLICATION FILED APR. 30, 1909
962,678. Patented June 28, 1910.



Witnesses
Inventors

REDUCED FACSIMILES OF ILLUSTRATIONS ACCOMPANYING TWO FAMOUS PATENTS.

The agitation of the ingredients specified by Froment will produce a froth; therefore, to the detached onlooker, it is difficult to distinguish the essentials of his process from those claimed in the basic patent of Minerals Separation. Mr. Sulman called the Froment froth a "tender and evanescent assemblage of bubbles of carbon dioxide carrying mineral," but if it carried mineral I do not see that his refusal to call it 'froth' is of any great consequence to those of us who are not interested in the litigation.

Coagulation. Here we come to what is apparently a break in the sequence of inventiveness, for, beginning with November 1902, Arthur E. Cattermole obtained a succession of patents for a process in which the idea of oil-selection is used to sink the metallic particles of an ore, not to float them. To an acidified pulp he added from 4 to 6% "of the weight of metalliferous matter present," not of the ore as a whole; therefore, with a 12% zinc ore this would mean 0.48 to 0.72%, say 10 to 15 lb. oil per ton of ore; and with a 2% copper ore, it would mean only 1½ to 2½ lb. of oil. But this oil "is brought into the condition of an emulsion in water containing a small percentage of soap or other emulsifying agent." These are the words of his most important patent, U. S. No. 777,273, dated December 13, 1904, but in his first patent, British No. 26,295, of November 28, 1902, he gives the proportion of soap as 2%. When this mixture of ore, acidulated water, and soapy oil is agitated violently the metallic particles are agglomerated into flocculent masses that sink, the separation from the gangue being then effected by an up-current of water. To facilitate the separation, the mixing was conducted in two stages, of which the second is said to have been "a rolling form of agitation." Cattermole called his agglomerate a 'granule'; Froment called it a 'spherule.'

Froth. The Minerals Separation company was organized in 1903 to acquire the Cattermole invention and thereafter his patents became part of the property of that company. The first and only plant to use the Cattermole process was erected on the Central mine at Broken Hill,[5] where it was soon displaced by the so-called agitation-froth process of Sulman, Picard, and Ballot. These gentlemen have testified that they made their discovery by experimenting with the Cattermole process, applying scientific methods of research, based on the fact that sometimes "loose flocculent masses of partially granulated sulphides" would rise, instead of sinking. Finally, they decided that this was due to insufficient oil. The actual experiments were made by Arthur H. Higgins, who, by diminishing the amount of oil to 0.62% on the ore, caused so many of the metallic particles to rise that a high recovery was obtained by flotation. H. L. Sulman says that by reducing the amount of oil the granulation was stopped and "coincidentally a mineral froth began to take its place." This was in March 1905. Whereupon the basic patent of Minerals Separation, British No. 7803, of April 12, 1905, was taken out by H. L. Sulman, H. F. K. Picard, and John Ballot, and subsequently they obtained the U. S. patent No. 835,120 of May 29, 1905, issued on November 6, 1906. In this patent reference is made to the Cattermole patent and it is claimed that the 'granulation' characterizing his method is stopped by reducing the amount of oil to "a fraction of 1% on the ore" and that by vigorous agitation the oil-coated particles are caused "to rise to the surface of the pulp in the form of a froth or scum." The use of 'scum' here is unfortunate for Minerals Separation, for it tends to identify the 'froth' made by this process with the 'scum' made by most of their predecessors in the art. In this patent acidulated water, warming of the mixture, oleic acid from 0.025 to 0.5% on the ore, oleic-soap solution, the formation of the froth, and the separating of the froth from the remainder of the solution are specified. Since this patent was issued the process has been applied successfully, and on a large scale, in many parts of the world, notably Broken Hill, Great Cobar, Great Fitzroy, Chillagoe, and Wallaroo, all in Australia; also the Braden copper mine in Chile; and more recently at the Inspiration, Anaconda, and other important mines in this country. It is proper to add that a froth-flotation process is used successfully at the Butte & Superior, Miami, and other mines, but the users deny that it is a method to which the Minerals Separation company has proprietary rights. The difference of opinion is yet to be settled by the Courts.

In the foregoing review, I have omitted reference to a number of flotation patents, some of them interesting, because the multiplication and repetition of detail would be only confusing. It will be noted that the amount of oil per ton of ore has decreased from over a ton[6] to less than half a pound. From an insistence upon the use of acid in all the patents, even to the last quoted in the above summary, we come to the recent fact of flotation in alkaline solutions. Indeed, in the case of the Mexican mill we are told that the deleterious effects of soluble sulphates was overcome by an excess of oil.[7] How much of the oil used in the prior art was due to excess of acid, it remains to be stated by an independent investigator. Much of the early work with flotation was done on Broken Hill ore, which contains a notable proportion of carbonates, hence the addition of acid proved a help, by generating gas, not only in the Potter and Delprat processes, but in others also, namely, those using oil. One ingredient, however, has gained progressively in importance: air. Other gases have had their day, some generated chemically, others electrolytically, but in the latest phase of the process the prime agent is air. Indeed, the good results ensuing from the lessened proportion of oil may be due to the fact that the less the oil the

[4]'Oil Films on Water and on Mercury.' By Henri Devaux. Translated and published in Annual Report of Smithsonian Institution, 1913. Also M. & S. P., July 31, 1915, page 156.

[5]'Flotation at Broken Hill. By James H. Hebbard. M. & S. P., September 4, 1915.

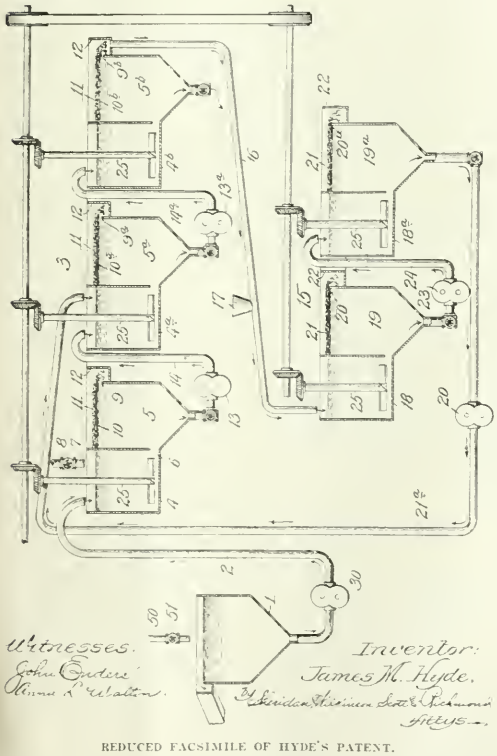
[6]'Notes on the Elmore Concentration Process.' By Charles M. Rocker. Trans. Inst. M. & M., London. Vol. VIII, 1899-1900, page 382.

[7]M. & S. P., July 24, 1915, page 124.

greater the intensity of agitation to cause it to spread throughout the pulp.[8] The vigorous agitation, so often emphasized, may have been like the shot that was aimed at the crow and killed the pigeon, for it must have done more than mix the ingredients: it resulted in entraining and atomizing a large volume of air. The later history of flotation suggests that a day may come when the oil, like the acid, may be found non-essential, and in its place will be added the ingredient that supplies the substance required for making bubbles. To make bubbles the surface tension of the water in the flotation-cell must be decreased by a contaminant and at the same time the viscosity of the liquid must be strengthened. Oil is not the only substance that can perform these functions. Some alkaline compound may be found that will do the trick. In the Cattermole, Sulman & Picard patent (U. S. 777,274) a fatty acid is produced *in situ*. In another patent, by Sulman, Greenway & Higgins (U. S. 962,678) a claim is made for the use of "an organic compound contained in solution in the acidified water" as a soluble frothing agent. In U. S. 1,055,495, Schick claims the use of carbon tetra-chloride to promote 'levigation,' or flotation. In U. S. 770,659, Scammell employs sulphur dioxide as a means for increasing the viscosity, and in U. S. 744,322, Foote uses slaked lime. Among other nostrums, alcohol, phenol, camphor, amyl acetate, benzoic and lactic acids, and calcium chloride have been suggested in various patents. In some cases, possibly, an ingredient of the ore itself may suffice. Meanwhile the element of time found essential to a good formation of froth suggests that the delay is useful in increasing the viscosity. Mere speed of agitation and aeration does not seem to suffice. But sub-division of the air helps. This reminds us that T. J. Hoover and Minerals Separation took out a patent, in Great Britain in 1910, for the introduction into the oiled pulp of air and other gases through a permeable medium, but it was not deemed worth while to obtain a patent in the United States. Knowing nothing about this, J. M. Callow hit upon the same idea and designed the porous bottom now in use at many flotation plants.[9] Cattermole used an ordinary cone or Gabbett mixer fitted with baffles. Froment employed a mixer of the egg-beater type. Sulman & Picard in one of their patents (U. S. 793,808) suggest an agitator made of a coil of perforated gas-pipe, through which compressed air and oil are fed. Centrifugal pumps, Pachuca agitators, air-jets, and pans with mechanical stirrers have been adopted by various inventors. Other devices for causing agitation and promoting aeration of the pulp have been, and are being, introduced. These, fortunately, are not likely to invite litigation, for most of them have been used already in metallurgical processes, notably cyanidation, in which oxidation by air is essential.

J. M. HYDE.
ART OF CONCENTRATION OF MINERAL SUBSTANCES.
APPLICATION FILED NOV. 10, 1911.

1,022,085. Patented Apr. 2, 1912.



REDUCED FACSIMILE OF HYDE'S PATENT.

Iron pyrite is often found in the 'clean-up' of gravel mining. In a Trinity County placer mine the amount was so large as to excite the curiosity of the manager. On investigating he found that clusters of fine crystals surrounded and adhered to fragments of waterworn slate and even to pieces of smooth water-worn gold. This association seemed to indicate that the pyrite is formed in place by percolating water. At Taxco, Mexico, a similar occurrence of freshly-formed pyrite in gravel was noted; in this case the pyrite was more abundant and carried so much silver that the whole bank of gravel assayed from 2 to 2½ oz. silver per ton. Prof. A. F. Rogers of Stanford University, to whom these occurrences were reported, states that it looks as though this pyrite may have been of recent formation. He finds a record of similar phenomena at Sulphur Springs, in Arkansas, at Carlsbad, in Bohemia, and in Iceland. Whitman was able to form pyrite from percolating water at a temperature a little above the ordinary; this experiment shows that the Trinity County pyrite mentioned above has probably been formed where it was found and has not been transported from a distance. Similar occurrences are mentioned in Lindgren's 'Mineral Deposits.'

[8]Dudley H. Norris has several patents for the use of water containing, in solution, air under high pressure for intensified bubbling, with or without oil.

[9]M. & S. P., May 29, 1915, page 826.

Mine Ventilation

At the Copper Queen mine, Bisbee, Arizona, the Spray, Gardner, Lowell, and Sacramento divisions are ventilated entirely by mechanical means. After the pressure and exhaust systems of ventilation were carefully studied, according to Charles A. Mitke, in a paper to the A. I. M. E.,* the former method was adopted. In this system, all mine fans were placed underground on the deepest working levels of the different divisions so as to draw the air down the intake shafts, force it through the workings and stopes, and exhaust it to the surface through upcast shafts.

The reasons for adopting the pressure instead of the exhaust system are as follows:

1. More practical. Since all the deep shafts of the Copper Queen are in operation and a large amount of work is done around each, as for example, men going on and coming off shift, handling timber, tools, and supplies, etc., it would not be practical to have an exhaust fan on the surface near the collar of the shaft. In the Gardner, a subway below the collar of the shaft would be out of the question. Consequently, a large air-tight chamber, inclosing nearly the entire head-frame, would have to be built if a suction fan were used.

2. Better control of mine fires. The pressure system is the more advantageous in case of mine fires. With this arrangement, the entire workings are under pressure, and the gas or smoke from a mine fire may be coursed to exit through neighboring shafts that are not in operation. Since the air is under considerable pressure at the bottom and sides of the present fire districts and each of the outlets over them is provided with regulator doors, the quantity of air passing through the fire zone can be increased or diminished at will, and consequently the fire can be brought under control more readily than with the exhaust system.

3. Greater efficiency. Since the Spray, Gardner, Dallas, and Sacramento shafts are natural down-casts, the mine fans were placed underground so as to take advantage of these circumstances and multiply the volume of the natural down-cast from five to ten times. The pressure system, therefore, has the advantage of the additional natural ventilation, which evidently would be lost with the other system; and more power would be required for the same quantity of air if the natural down-casts were changed to up-casts by suction fans.

4. Greater safety. Experience in the Lowell mine fire showed that in the event of the connections being closed between the fire and the suction fan, there is a possibility of smoke and gases entering the workings below and endangering the men. In the adopted system, the maximum air pressure is below the fire district, which makes it impossible for gases to go down, even if bulkheads of a sealed fire district should be opened suddenly by caving ground. At present a churn-drill hole is being put down to a depth of 1100 ft. over the old Lowell fire stopes. When this is completed water will be run in to cool the area. No trouble is anticipated, since this was thoroughly tried at the Holbrook, where a large amount of water was turned into churn-drill holes, and no smoke or gases were taken down against the pressure of the mine fan.

Advantages of New Ventilating System. (1) A smaller quantity of compressed air is used for ventilation. (2) All possible natural ventilation is utilized, and the general direction of air currents is the same for both natural and mechanical ventilation. (3) There is a decrease in temperature, and a lower percentage of humidity and CO_2 throughout the mine, which means healthier working conditions. (4) A saving of eight 5-hp. blowers was made, as these have been removed from the mine. (5) The five lower divisions are under pressure, which partly acts as a check in preventing some mine fires from crossing the Copper Queen side-lines, as for example, the proximity of one mine fire near the Gardner workings. (6) Less decay of mine timbers. (7) The volume of air has been increased from 60 to about 300 cu. ft. of air per man per minute. (8) Formerly a large amount of moisture kept the timbers and working places in a damp condition, and fungus also covered most of the timbers. Since the mine fans were started, a large amount of water is removed daily from each division by the air currents, so that the mine is comparatively dry and the growth has disappeared. (9) The increase in velocity and volume of air resulted in the greater efficiency of the men. And (10) the new ventilating system is advantageous to the mines adjacent to the Copper Queen; there is a great deal of broken and stoped ground along side-lines, permitting a large amount of air to escape through these avenues and ventilated stopes beyond the Copper Queen boundary.*

*'Ventilation of the Copper Queen Mines,' by Charles A. Mitke. Bulletin No. 105, American Institute of Mining Engineers, September 1915.

Carbide Lamps in Mines

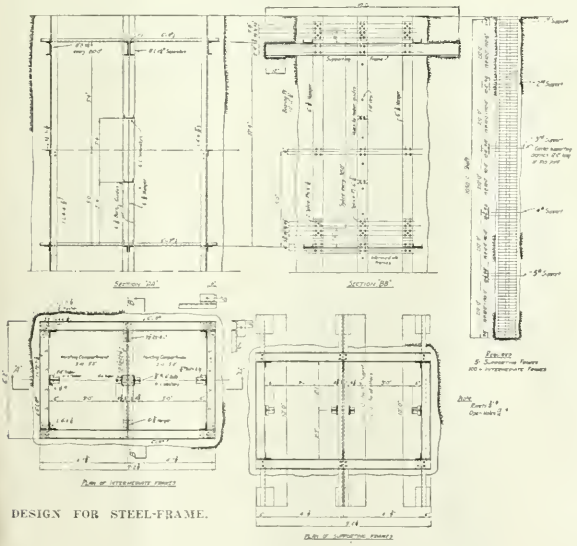
A type of open-flame cap lamp for burning acetylene gas, the gas being made within the lamp by the action of water on calcium carbide, and known to miners and the trade as 'carbide lamps,' has come into use in metal and coal mines of the United States in recent years. In some non-gaseous coal mines the open-flame oil-lamp, and in many metal mines the candle, has been replaced by this lamp. Fully 300,000 acetylene lamps are in use in mines of this country, 60% in coal and 15 to 20% in metal mines being of this type. A carbide lamp gives better light than a candle or oil-lamp, and so should reduce the number of accidents; it is clean and the flame produces little smoke; the gases of combustion are principally carbon dioxide and steam, and the acetylene is not injurious to health; the flame does not drop sparks that might ignite explosives, but the flame will set fire to anything quicker than the flame of an oil-lamp or candle; the general efficiency underground is better on account of better light; and the cost of upkeep is lower than that of the other lights.—James W. Paul in *Miners' Circular* 18 of the U. S. Bureau of Mines.

Steel Shaft-Timbering at Los Ocotes

By R. H. CROMWELL

*The Los Ocotes copper mine in the State of Oaxaca, Mexico, had been developed over a period of a number of years principally by the San Juan shaft. This shaft started as a small prospect working on the vein. It was more or less crooked and irregular in cross section, but as the ore was found to continue in depth it had been sunk intermittently in preference to starting a new and more elaborate shaft.

When 600 ft. in depth had been reached it was decided to sink 200 ft. deeper and then equip the shaft for regular extraction of the ore developed. From the 600 to the 800-ft. level the shaft was sunk two-compartment size. It was carefully plumbed from the surface, and the sinking was carried on in such manner that the cross-section of the shaft from the 600 to the 800-ft. level would square up with the proposed enlarged and straightened cross-section of the shaft from the surface to the 600-ft. level. The rock was quite solid, lagging being required in only a few places.

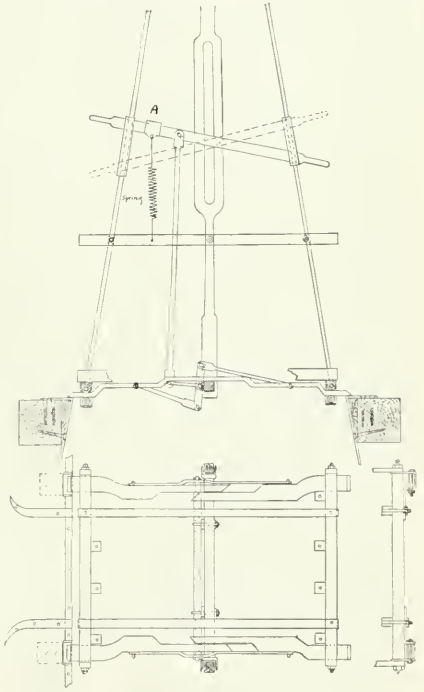


DESIGN FOR STEEL-FRAME.

Timber in this shaft rots quickly, even when protected with coal-tar; timber sets could not be relied upon to last more than three years. A considerable body of ore had been developed, and it was therefore assumed that the shaft would be used for a number of years. For these reasons it was decided to equip it with a steel headframe and steel timbering.

*Abstract from the *School of Mines Quarterly*, Columbia University, No. 2, 1915.

In enlarging and straightening the shaft from the surface to the 600-ft. level, it was found most advantageous to work from the surface downward. A heavy swinging wooden platform or *balsa*, about the size of the finished cross-section of the shaft was constructed, and was used for supporting the men engaged in carrying down the enlarging benches in the shaft. This platform was swung from four cables attached to its corners and joining in a central single cable operated by a small hoist on the surface. Before a round of holes was fired the platform could therefore be raised and quickly lowered into place again after blasting. This saved a good deal of time and at the same time protected the steel timbers. As ventilation in this shaft was excellent, after a round of holes was fired, but little time was lost in lowering the *balsa* and getting a new round of holes started. As the trimming and enlarging of the shaft proceeded downward, bulkheads were put in successively at the different levels below the point where trimming was going on. From these bulkheads the material blasted from the shaft was removed currently and stored in the different



AUTOMATIC CHAIRS FOR MINE-CAGE.

levels, from where it could be economically hoisted when the steel head-frame and shaft-timbering was complete.

We first attempted to use air-hammer drills mounted on light columns for the trimming and enlarging of the shaft, but it was found that the natives lost too much time in preparing set-ups and making connections. Better progress could be made by hand-drilling, as in some cases only short holes were required. About 6 ft. of shaft was trimmed per round. The men would shoot whenever a round of holes had been completed. Plumb-bobs from the four corners of the collar of the shaft were lowered to the trimming bench after each round of holes was fired, the position of the new holes being determined by the plumb-bobs. During trimming operations, water was being removed from the bottom of the shaft by a small Cameron pump driven by compressed air. Before blasting, lengths of both water-columns and air-pipes were removed at the point in the shaft where the round of holes was to be fired. After these holes were blasted and the loose ground barred down, the pipes were replaced and pumping resumed.

The steel timbering shown in the drawing, was put in as fast as the trimming of the shaft progressed. The ends of the flat 6 by $\frac{3}{8}$-in. hangers, to which the sets were bolted, were maintained at sufficient distance from the trimming-bench in the shaft so that blasting could not injure the steel timbers. They were also protected by the *balsa*, which, before each blast, was always raised from the bench to the bottom of the steel hangers.

The drawing shows supporting sets of 8-in. steel channels which were cemented into steps and into the sides of the shaft. These supporting sets, from which the steel timbering hung until securely wedged to the sides of the shaft with blocking, were installed just below the collar and at 210-ft. intervals in the shaft.

All the steel, before being installed, was painted with a mixture of coal-tar and turpentine. The steel went together rapidly and without difficulty, and after each set was blocked up the whole structure was rigid. From the surface to the 600-ft. level, sets were put in 10 ft. apart. From the 600 to the 800-ft. level, as the ground showed a tendency to cave, sets were put in every 5 ft. and lagged with 2-in. planks laid lengthwise between sets.

For the timbering of this shaft, about 73 tons of steel was required, costing approximately $100 U. S. currency per ton, laid down at Los Ocotes mine. The steel head-frame contained 15 tons of steel, which cost about $140 per ton laid down at the mine.

In connection with the equipment of the shaft at this mine it was planned to use chairs attached to and operated from the cages. Referring to the sketch of this arrangement, a weight or spring at A automatically withdraws the chairs when the cage is raised and its weight taken from them. The arrangement was devised by John Martin of Tariche, Oaxaca, and has proved satisfactory at the San Juan mine of that place. It has the advantage of avoiding the expense and danger of having sets of chairs at each of the levels from which hoisting is being carried on. In operating the automatic cage chairs, the cage-man holds the lever against the action of the weight and spring until the protruding chairs rest upon the landing and are held in that position by the weight of the cage.

Brazilian Mining Titles

In 'Mineral Resources of Minas Geraes,' A. F. Calvert states that "it has been proved beyond all shadow of a doubt that Brazil possesses an incalculable wealth of mineral treasure"—nevertheless "the Brazilian mining industry at the present moment is in an almost moribund condition."

Mr. Calvert explains, on the authority of *The Times* that this incomprehensible neglect is due in the main to bad legislation, and to the fact that the adventurous life of the gold-seeker appealed to but few Brazilians and he also gives other reasons that seem inadequate to account for the neglect of mining in Brazil. We say the reasons are inadequate, for similar causes have not prevented the investment of foreign capital in other regions of the world not as well situated as Brazil.

There is, however, an adequate explanation of the neglect of mining in Brazil, and one of the chief causes of this neglect is the lack of mineral deposits that can be worked profitably under existing conditions. In other words, not even in Brazil are diamonds, gold nuggets, and rich gold quartz-veins to be found tasily. Another potent cause that deters foreign capitalists from investing in Brazil is the great difficulty in obtaining title to real estate. We heard a most lucid, instructive, and amusing account of these difficulties in an after-dinner speech by a noted American geologist who is thoroughly familiar with Brazil. An instructive after-dinner speech is so rare that we remember the details very distinctly. The speaker explained that when a greenhorn buys a mine in Brazil, the titles seem to be all right and there is no difficulty in acquiring possession of the property. After a reasonable interval, however, a pleasant gentleman appears and inquires why the foreigner is working on his property. Investigation shows that the claimant has good ground for his assertion and he is bought off as cheaply as possible. But no sooner is he disposed of than claimant No. 2 appears, and so on until the foreigner becomes disgusted and departs for some country where some form of title registration is in force. The trouble with the Brazilian titles arises from the granting of vast concessions in the early days to the pioneers. These pioneers usually had large families and the estate descended to the family as a whole and not to any individual. As long as the ownership of the land is confined to the descendants, some basis of agreement is reached by which Manuel Silva can have the part he occupies and Juan Fernandez can retain his portion, but when the foreigner arrives every member of the family must be dealt with individually, and with a large family the result is financially ruinous. This difficulty of obtaining titles is, of course, not insuperable, but the acquiring of a good title needs more time, money, and patience than the average European or American possesses.

Practical Ideals

By GEORGE OTIS SMITH

*Men agree that times change. But whether we are reviewing geologic eras or epochs of human history, it is true that certain of these periods of time are characterized by much more rapid change than are others. Neither the rate of earth evolution nor that of human progress has been constant. In this twentieth century we look out upon an environment peculiarly adapted to the rapid generation of ideas and their almost instantaneous world-wide dispersion. An idea can encircle this globe in a few hours, and within the week, stand out on the printed page in all the languages of the civilized world.

"Practical ideals" is thus more than an apparent contradiction of terms—it is the real thing that the world demands. The practical ideal is the ideal in its everyday form that has the power to uplift because it is firmly braced on the ground. Just as the facts of the mine and furnace and rolling-mill must be used in the laboratory of the technical school, so on the other hand the ideals of the university need to be taken into the market-place. Here is the proving-ground where theory encounters fact, and where opinions are put to the acid test of experience.

Present-day reformers like William Allen White and Shailer Mathews have not been the first to proclaim that "the old order changeth, yielding place to new." Down through the centuries of recorded history, while human nature has remained much the same, social conditions have changed almost without pause. Many reforms, however, are now being realized so rapidly that what is a commonplace in 1915 was at best only a vision when this century opened. The 'impossible' is being enacted into effective law so frequently now that only the blind can fail to read the signs of the times.

Last winter at a Senate Committee hearing when water-power legislation was under discussion, the usual conflict of thought developed between the lawyers who cited the limitations set by the Constitution, and those of us who urged the needs of the public. In an attempt to define this antagonism of opinion, I repeated to the Committee my remark to an eminent lawyer after hearing his constitutional argument. "It seems to me that the chief difference in our point of view," I said, "is that the student of the law thinks what cannot be done ought not to be done; while others of us believe that what ought to be done can be done"; or as I would express it tonight, the ideal can be made practical.

These rapid changes in the social order, of course, necessarily follow the increasing complexity of civilization, yet I venture to suggest that none of us comprehends the full extent of these changes in commerce and industry. It has been figured that it would take a caravan of half a million camels to transport the wheat which in a single day passes over any one of our great railroad lines during the season of crop movement. And when it comes to the product of our coal mines, which furnish the staff of life to America's industries, the camel as a unit of transportation cannot be used in any simple calculation; for a year's output of the coal mines of this country would fill more than eleven and a half million of our largest coal cars, or a train long enough to encircle the globe three times at the equator.

I am hinting at the differences between the world of today and that of yesterday; you students of engineering science know how rapid is the march of improvement in industrial processes and methods. The scrap-heap is piled high with machinery that only a few years ago won and deserved the admiration of the world, but that is now displaced by something more efficient. And all this progress has affected the problems of government, and more particularly those of a democratic government. Changes so marked in the material or business environment compel social and political reconstruction.

The new political economy, as I see it in the making, is putting a larger emphasis upon the interdependence of all members of the community—in fact, it is the community idea that stands out. The brotherhood of man is an ideal constantly preached to mankind for nineteen centuries, but now this ideal has become a practical factor in affairs of State. The moral element in the economic questions before the public is not to be overlooked, and recent progress in this respect has been most striking. Take for illustration the law protecting women factory-workers: on the question of its constitutionality the highest court of New York reversed itself within eight years, the justices holding that the health of woman is a matter of vital importance to the State. Within these few years the attitude of both the public and the court has radically changed.

The intimate union of the practical and economic with the ideal and moral may be seen also in the liquor question. Most striking of the war measures taken by the great European nations have been those aimed against the drink habit—simply in the aid of efficiency. So, too, in this country, the political question of suppressing the liquor traffic has become hardly less an economic than a moral issue. The interest of the citizen in his fellow's welfare thus becomes real and active in a highly organized democratic civilization.

The extent of the share which the consuming public has in the conduct of certain industrial operations on a large scale is being recognized in the courts. In a recent decision in New South Wales, for instance, the court upheld as legal and in the public interest, certain trade agreements among coal-mining companies and shipping companies. From New South Wales it is a long, long way to Illinois, yet the conditions in the coalfields of these two States may not be altogether diverse. In that far-away country, cut-throat competition had followed the development of a new field with the result that prices prevailed which the court described as disastrously low.

*Part of an address delivered at the Annual Joint Meeting of Sigma Xi and Phi Beta Kappa, University of Illinois, May 4, 1915, by the Director, U. S. Geological Survey.

The justification of the combination was stated by the court with a logic that appeals to the non-legal mind. "The consumers of coal will lose in the long run if the colliery proprietors do not make fair profits or the miners do not receive fair wages."

Coming back to the same problem nearer home, I may mention a fact which may not have been given publicity. More than once in the last six years strong delegations representing large bituminous coal-mining interests have come to Washington seeking authority for a trade combination. The purpose of such a combination was not concealed—it was to raise the price of coal so as to make the business truly remunerative; but in order to secure a price properly related to cost, these hard-headed men of 'big business' proposed that the fixing of that price should be absolutely under Federal regulation. I believe they had a good case, and although they urged something for which the times were not ripe they were in fact presenting a proposition promising as much to the public interest as to their private gain—this will be a practical ideal as soon as legislation catches up with business.

The competitive element in business need not be thrown aside—it has not outlived its usefulness. But competition must be fair. For big business or for little business, government should lay down the rule that the winning of a market naturally follows the proffer of better quality or lower prices. The buyer, whether he lives in a South American city or on a New England farm, wants the most and the best for his money. Enforce this rule, and trade competition will resolve itself into a contest decided by the constructive contributions made by the inventive organizer and the skilled laborer. In short, the goal of fair competition is excellence of product secured through efficiency of producer.

Regulation by the Government, moreover, means the protection of the corporation as well as of those served by the corporation. The fear that the courts could not safeguard the interests of all has proved groundless. Two recent decisions by the Supreme Court may serve to illustrate this. The public service character of a railroad does not exclude the essential idea of a reasonable reward. Government control, whether State or Federal, cannot be arbitrary; facts of profit and loss must control questions of rates. In the Norfolk and Western case the Court decided that the fixing of a two-cent rate is not justified if thereby merely a nominal profit is earned on the interstate passenger business. The Northern Pacific decision is even stronger in the Court's limitation of legislative powers. North Dakota had sought by statute to fix rates for coal that would promote utilization of the lignite of that State, a policy in line with conservation. The Court, however, states that the public interest cannot be invoked as a justification of arbitrary demands that require transportation of freight at less than the proper cost, or even virtually at cost, and thus deny to the railroad a reasonable reward for service. The public cannot even require a railroad to carry coal at a loss, on the supposition that the receipts for the carriage of wheat will show a profit on the freight business as a whole. The dominant principle is that the Government should protect the public user and private owner.

Most important is the contribution of the higher education to American citizenship. A few of you—let us hope many of you—may enter the public service and serve your home town, your State, or your nation as responsible and responsive public servants, efficient because expert, faithful because patriotic. To all of us, however, comes the opportunity and the obligation to be citizens and to take the duties of citizenship no less seriously than we would those of public office. It is you to whom the nation must look not so much for office-holding as for leadership in public opinion.

The compelling argument for engineers to step forward as citizens is the evident fact that politics has not kept pace with science. Take the political conditions of this or any other country, of this or any other day: they are characterized by uncertainty, confusion, and hazards that the business man would at once cut out of his own business and should eliminate from the nation's business. On the king's highway of ancient times, slaves worked without respite to make smooth the path for royal use, and today the American railroad invests millions to straighten curves or reduce grades, but on our political right-of-way, obstructions and obstacles which make all progress expensive, if not uncertain, are allowed to remain simply because these so-called institutions are our heritage from our fathers and our fathers' fathers. To look backward and to search for precedents seems to be more than a habit with statesmen; it is rather a part of their professional code.

Sigurd Ibsen, son of the dramatist, in his volume of suggestive essays entitled Human Quintessence, has used an expressive term—*the lag of politics*. As you students of mechanics might state it, the mass conditions of statecraft are expressed as inertia while those of science are expressed as momentum; the one is static, the other dynamic. As Ibsen himself states it: "What is called conservatism or maintenance of tradition consists in large part in efforts to lengthen the shadow life of bygone thoughts and orders: it is the past that shall decide for the present, it is the dead that shall rule over the living."

The most philosophic of American geologists, Professor Chamberlin, after studying exhaustively climatic conditions in the long geologic past and after weighing carefully the possibilities of disaster to our earth from collision with some star, has shown that we have good reason to measure the future habitability of the earth at millions or tens of millions if not, indeed, hundreds of millions of years. Sharing Professor Chamberlin's inspiring belief in the probability of racial longevity, do we not gain a real incentive to scientific research into the greater utilization of the forces of nature, an added argument for the application of the truths of science to civic progress, and a larger faith that the Golden Age is in the future—that the highest development of our country and of the world is to be witnessed by those who are to follow us? Are not our ideals practical and is not such a vision a call to larger service?

Manhattan, Nevada

By PERCIVAL NASH

*The geology of the Manhattan district shows that the main ore-bearing formations are sedimentaries, schists, limestones, and quartzites. North of the ore-zone of the district is found rhyolite, although in Slaughterhouse gulch, which is one of the boundaries of the known ore-zone to the north, a large intrusion of andesite exists, probably of the same age as the Tonopah andesites. Granite is found to the extreme south of the mineral belt.

The sedimentaries are considerably altered, owing to the granite intrusion, this being particularly the case from the Big Four mine eastward. From the extreme metamorphism shown, it is inferred that granite will be found to underlie the eastern portion of the district—the granite being older than the sedimentaries and younger than the rhyolite. The period of ore deposition probably followed the andesite intrusion.

Extensive block-faulting throughout the district complicates the structural geology. Accompanying the larger faults are found a series of smaller faults striking a few degrees east of north, and in these smaller faults most of the ore has been found.

Throughout the schist innumerable small veins are found, suggesting that the ascending mineral-bearing hot waters followed these fractures and spread into the schist, covering large areas. This is shown through the Gold Hill area, from the Big Four south through the Big Pine, Jumping Jack, and Mayflower properties. In the limestone belts also the ascending waters followed the main fault-channels and spread into the easily soluble limestone. The rich surface ores are due in part to secondary enrichment.

The White Caps claims are farthest east. The ore occurs in limestone in close connection with faults. The faults themselves do not contain much ore, which near the surface is oxidized; at a vertical depth of about 130 ft. it changes to a sulphide. The minerals found in the unoxidized ore, besides gold, are stibnite, realgar (sulphide of arsenic), iron pyrite, and a trace of copper. The gangue is a coarsely crystalline calcite; the limestone has been replaced by a dense dark quartz. An interesting feature is the almost total absence of silver. The faults dip west and southwest, and the orebodies appear to underlie the faults as if the fault-zones acted as a dam and impounded the mineral-bearing solutions into the limestone.

Three orebodies have been developed in the White Caps property; the eastern is much the largest as yet developed. It is about 130 ft. long and in places is 24 ft. between walls, the average width being 10 ft. From the middle orebody a large quantity of rich ore has been mined. West and south from the middle orebody, nearly 200 ft. distant, another large vein has been exposed. From the bottom, or 200-ft. level (vertical), this western orebody proves to be about 80 ft. long, averaging 8 ft. in width for most of its length, although in one place it is more than 20 ft. wide. A raise proves it to be 'blind', the orebody ending about 30 ft. below the surface.

The company's records show that 19,909 tons has been mined during the past three years, mostly by lessees, averaging $19.94 per ton. On the surface there is now about 6000 tons of ore awaiting milling facilities. The White Caps company has installed a complete mine equipment. A new vertical shaft has been sunk in the hanging wall of the orebodies in solid ground.

The Manhattan Consolidated property is in close proximity to the White Caps, and has developed a large orebody somewhat similar in character to that of the White Caps. The Consolidated has produced 9075 tons of ore, valued at $127,000.

Litigation hill joins the Consolidated on the west. The hill is about 2500 ft. long, of rounded nature, rising from the gulches on each side for a height of about 100 ft. for most of its length, but at its eastern crest being about 250 ft. from the floor of the valley. On this hill are found the Earl, Manhattan Amalgamated, and Litigation Hill Merger properties, consisting of five claims. A well defined bed of limestone traverses the full length of the above-mentioned hill, the course of the bed being east and west, with an average width of over 200 feet.

The lime is a coarsely crystalline carbonate and is readily soluble. In the deposition of orebodies, it has been replaced by silica and changed into quartz. The lodes developed by the Manhattan Consolidated in the eastern portion of this limestone are in east and west fissures that show strong fault-movements, interseeted by cross-veins along vertical fissures.

In the eastern portion of the Merger property the veins come together, and in several places chimneys of rich ore have been mined, in one case for a depth of over 500 ft. All three properties are equipped wth mining machinery, and considerable development has been done during the past three years. An important ore-shoot was opened between the Amalgamated and Earl properties at a vertical depth of 250 ft. Unfortunately, title to the orebody in question is undecided and for that reason neither company has attempted to extract the ore except in development. Litigation hill has yielded 9615 tons of ore of an average of $19.12 per ton, a gross value of $183,848.

The Gold hill area is in the centre of the district, and at present is the scene of the most important mining

*Abstract from *The Tonopah Miner*.

operations, the Big Pine open-cut work. On the crest of Gold hill is the Big Four property, with a fine mine equipment and a 10-stamp mill. The ore in this section is in a schist-zone, in places 50 ft. wide. The Big Four has a shaft sunk to 500 ft. The first large profits from the property were made by lessees. In the first 100 ft. of sinking, 100 tons of ore was mined averaging $325 per ton in the mill. The first lease also produced 1100 tons yielding $22 per ton. The second lease, which brought the Big Four mine into prominence, produced nearly $500,000. After the company took over the property, ore worth about $85,000 was mined and milled.

The length of Gold hill is about 3000 ft. Directly south of the Big Four, the Jumping Jack company cuts through with the eastern end of its claim into Gold hill. It was from the second level of the Jumping Jack workings, in September, 1911, that Mushett and Wittenberg, the present operators of the Big Pine, cut through to the south and east, cross-cutting the mineralized schist-zone. This zone has been proved from the Big Four to extend, following the line of the hill, for over 2000 ft. south, and from 50 to over 100 ft. in width, with a developed depth of over 200 ft. vertical.

The Big Pine claim, for over 1000 ft. takes in the schist-belt. About 350 ft. from the north end-line of the Big Pine is the Mushett and Wittenberg vertical shaft, sunk to 200 ft. Between the working-shaft and the northern limits of the claim, the ore found in the schist is being mined by glory-hole methods, being caved from the sides and ends of the opening in benches, dropped to the 200-ft. level into chutes, from there trammed to the shaft, and then raised to the surface. During the past year the present glory-hole has been worked, and its dimensions now show ore for 310 ft. north from the shaft, 50 ft. wide, and 200 ft. deep, equal to 240,000 tons of ore, from the surface to the 200-ft. level.

The mine and mill records show the following for July, 1915: The mill operated 86% of the month, lost time being due to installation of new crusher, trommel, etc. A total of 4409 tons passed through the tube-mill at the rate of 7.42 tons per hour, 178 tons per day. There was 12,000 tons broken, hoisted, and crushed during July. The tailing averaged 40c. per ton. The highest heads in the mill averaged $5.60, and the lowest averaged $2.20 per ton. The actual operating, mine and mill, cost during July,—including labor of installation, additional machinery, electric power, explosives, incidentals, etc., and the cost of development, south drift from 200-ft. level—shows an average of 46c. per ton hoisted and passed through the crusher. The work south from the main working-shaft, both from the 200-ft. level and by trenches on the surface, and glory-hole work on the southern end of the claim, proves that south from the shaft the known extent of the ore-zone to the 200-ft. level to be 400 ft. long, 75 ft. wide on the surface, but with an arbitrary average of 60 ft., equal to 370,000 tons.

The Reilly Fraction is a fractional claim adjoining the Big Pine to the south, and is owned by the Salsberry interests. Glory-hole operations in the schist produced about $100,000 worth of ore.

The Dexter Union Mines Co. has the largest holdings in the district, owning 16 patented claims. The Union Four claim, directly north and side-lining the Litigation Hill, has produced the most ore of any of their claims. At the present time Dexter Fourteen claim, lying north of the Big Four property, and covering the northern slope of Gold hill, is making a good production, the surface of the hill containing considerable placer gold, with deep placer workings in the main Manhattan gulch, across which the claim extends.

The Wall and Blaker properties are situated near the summit of the range on which the Manhattan district lies, south and east from the centre of the district and about two miles from Manhattan gulch. These properties during the past year have attracted considerable attention, owing to the large orebodies found there. The deposits seem to be mostly of a blanket nature following the contour of the hillsides, but further prospecting may prove the continuity of the ore in depth. Strong granite intrusions show directly west and south of the lodes. The Wall properties are being operated by Omar Maris and H. Z. Peters under bond and lease.

West from Gold hill is the Union Nine claim of the Manhattan Dexter Mining Co. This claim contains one of the strongest veins in the district. It was one of the first properties to be operated after the discovery of the Manhattan. About $500,000 is the known production by lessees of the company. On both ends of the claim the orebodies have proved to be large. In the Plamenaz lease they have been opened on the south end to a depth of over 400 ft.; on the north end, in the Briggs-Evans lease, to a depth of 240 ft. The mineralization in the Union Nine property is along a fault-plane, with oreshoots due in part to the intersection of the main fault by minor faults.

Directly adjoining Union Nine northward is the Little Grey claim, now under development by the Nevada Mining & Development Co. A depth of over 300 ft. has been reached in this property, and an orebody developed from that point, for a length of 160 ft. This is a continuation of the vein worked by Briggs and Evans in the early days of Manhattan, their lease-block being only 80 ft. south of the Little Grey working-shaft.

Among the mills of the district is the Associated mill, a custom-plant, close to the White Caps and Consolidated properties. This mill is equipped with an automatic sampler, 10 stamps, amalgamating-plates, tube-mill, complete cyanide-plant, and refinery.

On the Union Four claim of the Dexter-Union Mines Co. a 10-stamp custom-mill with straight amalgamation is being operated by Whitman & Kane.

The Manhattan Milling & Ore Purchasing Co. owns a 10-stamp mill, sampler, tube-mill, and cyanide-plant situated on the Wolftone claim close to the Little Grey.

The largest mill at Manhattan is the War Eagle. It has 20 stamps, 2 tube-mills, amalgamating-plates, and complete cyanide-plant. This mill is situated on the Mustang property, a low hill directly opposite the Little Grey and Dexter properties, but with Manhattan gulch between them.

The Round Lake Mine

By C. P. BOWIE

The Round Lake mine is situated in Plumas county, California, about 9 miles by wagon-road from Blairsden, a station on the Western Pacific railroad in the Mohawk valley. The mine and mill are at an elevation of about 6500 ft. above sea-level, in the Plumas National Forest, and are most picturesquely situated on a mountain-side immediately above a small body of water about a quarter of a mile wide and almost circular in shape, known as Round lake, from which the property derives its name.

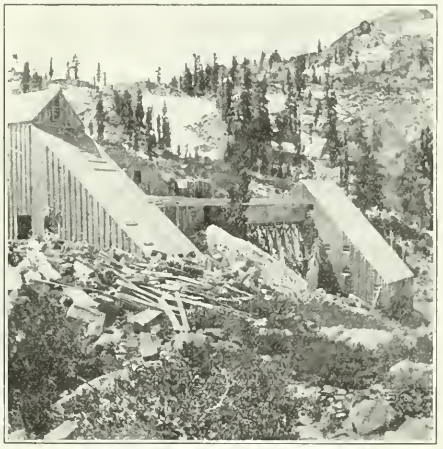
The outcrop of the vein, where it was discovered many years ago, was at the very water's edge and its strike and dip to all appearances carried it directly across the lake, although no sign of the vein has ever been found on the opposite bank. For this reason the prospect remained as such for a generation or more; locator after locator complied with the assessment law for a season or two and then allowed his rights to lapse, since the drainage of the lake presented difficulties and entailed an expense too great to warrant a venture, with no better outlook for reimbursement than that the ore might persist in depth.

It was not until the year 1911 that the present owners, M. H. Miller, who now personally superintends the operation of the mine and mill, in conjunction with W. P. Hammon, of San Francisco, and the Downer brothers, of Goldfield, took definite steps toward development. They, however, have made no attempt to drain the lake, but in lieu thereof started an incline on the hillside about 300 ft. above the outcrop. They cut the vein a short distance beneath the surface and have since worked only that portion of it lying above the water. The total depth of the incline is 350 ft., descending at an angle of about 45°. As a matter of fact, the bottom of the shaft is 60 ft. below the surface of the lake; however, no ore is at present being extracted from that depth. The incline has two compartments, a skip-way and a man-way, and is carefully and neatly timbered with stulls and lagging shaped from silver and white pine, respectively, which abound in the vicinity.

The surface improvements consist of a hoist-house, containing besides the head-frame and hoisting-engine, a blacksmith-shop and an ore-bin, into which the skip dumps automatically. The power for raising the skip is provided by an 18-hp. Western gasoline engine, which Mr. Miller reports as giving excellent satisfaction. There is also a mill, connected with the hoist-house by a covered runway about 100 ft. long. The mill is of sufficient size to admit of 10 stamps and the necessary adjuncts, but up to the present time only 5 stamps have been installed. The ore which is trammed by car from the bin at the collar of the shaft, is dumped onto grizzlies through which the fine passes direct to the bin that feeds the stamps, the larger pieces of ore being hand-shoveled into a crusher.

From the stamps the pulp passes through a 40-mesh screen over the usual copper plates, where the gold is arrested. The tailing, of which there is already an accumulation of 1000 tons, is at present being allowed to run directly into the lake; it being the plan later on, if satisfactory arrangements can be made with the Forest Service, to drain the lake, which, from soundings, seems to have a maximum depth of not over 60 ft., and recover the tailing, should circumstances warrant. The mill has a capacity of about 16 tons per day. Power is furnished by a Doak gasoline engine and the necessary water is pumped from the lake.

The vein has a width of from 6 to 10 ft. and strikes



THE ROUND LAKE MINE AND MILL.

northwest. The dip is east and varies from 15 to 40°. The vein-matter consists of white quartz, which is brittle and easily milled, and which in depth carries a considerable proportion of iron sulphides. Both the foot and hanging walls are of the same material, being composed of an igneous rock rich in feldspar, augite, and hornblende, so that it can be labeled a gabbro. The gold in the vein averages from $16 to $28 per ton and is fairly distributed across the entire width. This obviates the necessity for sorting the ore or in any other way handling waste; all the rock broken in the stopes is hoisted direct to the surface and milled.

Power may cost one company less per hour and yet the cost per ton be greater. An instance is given where a plant was generating electric power for 1 cent per kilowatt-hour and the cost of power per ton was 45 cents. An adjoining mine produced power for 1.25c. per kw.-hour and yet the cost per ton was only 25c. Investigation showed that the cheap-power company was wasting $80,000 yearly through imperfect and superfluous pumps and machinery.

The Balboa air-compressing plant, Panama Canal, produced 151,915,500 cu. ft. of free air compressed to 105-lb. pressure in June. The Gatun hydro-electric plant yielded 2,464,280-kw. hours.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting

The principal sheet-ground orebodies at Joplin, Missouri, lie at an average depth of 180 ft. in chert.

Cyanidation of tailing from the primary veins in the slate of the French Gulch and Deadwood districts of Shasta county, California, has not been successful. Some slate is mined with the ore, and owing probably to premature precipitation of the gold from solution by carbon in the slate, cyanide treatment is not practicable.

Free or loosely combined lime is generally considered to be the primary cause of unsoundness in portland cement. On hydration, free lime, according to fineness, hydrates as crystalline or amorphous calcium hydroxide, which disrupts cements. High-pressure steam is used to test samples of cement blocks for this weakness.

To meet the requirements of individual drive for machinery of various kinds, the electric motor must not only be compact, but must permit of being mounted in any position, while the windings and commutator must be partly or wholly protected from external injury. The motor must also be capable of standing sudden and heavy overloads.

Jade from New Zealand is the mineral nephrite. The Maoris called it *pounamu*. It is usually found as boulders in the glacial debris and from the boulders all the jade, or greenstone, ornaments have been made. The largest boulder, weighing five tons, was sent to Germany. The price averages 30 cents per pound and the average amount exported is 18,000 lb. The Chinese are profound connoisseurs in jade, but prefer that from Tibet.

Fifty stamps, 10 five-foot grinding-pans, and three 18 ft. by 4½-ft. tube-mills at the Sons of Gwalia mine, Western Australia, crush nearly 14,000 tons of ore per month. The average stamp-duty is 10 to 12 tons per day through 6 or 8-mesh screens. Of the tube-mill product 90% passes 150-mesh. The pans receive a pulp containing 40% on 60-mesh, and discharge 50% through 150-mesh. The Freeman selective pipe-discharge is fitted to them. The muller revolves at 60 r.p.m. The shoes and dies, 4½ in. thick, last 45 days.

Pneumatolysis is a process of mineral formation in which gases and vapors play an important part. When aqueous solutions aid in the result, the process is called pneumatohydatogenesis, which is a good expletive for a fishwife. Minerals formed by pneumatolysis occur chiefly around volcanoes. The exhalations are variously named: Fumaroles give out nitrogen, hydrogen, hydrochloric acid, hydrofluoric acid, and silicon fluoride. *Solfataras* exhale sulphur combinations. *Mofettes* are characterized by carbon dioxide; while boric acid vapors are termed *soffioni*. The intensity of pneumatolysis is shown by the filling of a lava crack with 3 ft. wide of specularite in 10 days—at Vesuvius in 1817.

Demons or gnomes are supposed to control the fortunes of miners. Malicious or amiable, they lead the miners to *borrasca* or *bonanza*. The belief in these imaginary beings still persists among the astrologers whose advertisements in the newspapers show all degrees of fraud and credulity. In the Middle Ages such belief was well-nigh universal. Indeed, the darkness of the mine, the sudden noises, the air-blasts, the explosive rocks that maim or kill, the sudden inexplicable changes from rich ore to waste rock, or the reverse, all tend to cause a belief in the supernatural. In the days of old these spirits were classified: *Goblins* were seen by men going to work or when attending cattle; *guteli* were good spirits; *trulli* were in the form of women or men and worked as domestic servants; *incubi* and *succubi* caused dreams.

Ore deposits are best represented by models, so constructed that the deposit is shown as a solid suspended from the mine openings; which are most easily represented in wood or copper wire. In default of models the following plans are absolutely necessary. 1. A ground plan, or projection of all the workings on a horizontal plane. 2. A separate ground plan of each level. 3. A longitudinal plan, that is, the projection of all the workings on a vertical plane parallel with the strike. 4. A stope plan or projection on the plane of the vein. 5. A series of transverse sections at right angles to the strike at various points. 6. Longitudinal sections parallel with the plane of the vein at different points. In the mines at Przibram horizontal plans are made at every 20 ft. and similar plans are made every 7 ft. in some Russian mines.

Gold pocket deposits in the Klamath mountains of northern California have been formed by a combination of favorable conditions, according to Henry G. Ferguson. The process of pocket formation seems to have been as follows: Gold, released from the original position in the pyrite of the low-grade manganiferous quartz veins, is taken into solution by nascent chlorine, formed by the action of sulphuric acid on a chloride with a manganese peroxide present as oxidizing agent. The peculiar conditions of the slate and meta-andesite contact have controlled the flow of these waters, which, unable to penetrate to any extent through the gouge-like slates, necessarily follow the slate-contact, particularly along the slate re-entrants. It is along this contact that the precipitating agencies, carbonaceous matter, pyrite and arseno-pyrite, are effective. The calcite neutralizes the gold-bearing solutions before they can proceed far from the source, and prevents continued migration downwards. Long erosion to the level of the Sherwood peneplain and below it in the stream valleys, has afforded an excellent opportunity for gradual deposition of the gold in these pockets.

The First-Aid and Mine-Rescue Contests at the Exposition

The week ended September 25 was 'Miners' Week' at the Panama-Pacific Exposition. The most interesting events were the first-aid and mine-rescue contests, held on three days. Complete arrangements were made for them, and the meet is considered to have been the most successful ever held in the United States. There were no disputes, all being satisfied with the decisions. It was the first time where coal and metal miners met, and it is interesting to know that, although the latter have not had more than 25% of the training of the coal men, the metal teams won the most of the contests. A year ago there was not a first-aid team in California, yet 10 separate California mines sent teams, and they did well.

As interesting as the contests were the five coal-dust explosions, the first made in this State. Four were on Pittsburg coal dust, crushed to from 100 to 200-mesh; and the fifth on Washington coal. For these demonstrations a 72-in. diameter fir-stave pipe 110 ft. long was constructed to act as an explosion-gallery. It was designed to stand a pressure of 25 lb., the pressure resulting from the explosions being from 12 to 15 lb., gradually diminishing to a low pressure at the open end. From 75 to 100 lb. of coal-dust was sprinkled in the gallery, as it occurs in a mine, and 1¼ lb. of 3F black blasting-powder was fired from a cannon into the gallery, representing a windy shot. The flame of a charge of this powder is long, hot, and of considerable duration, and gives sufficient heat to fire the dust and start an explosion extending through the gallery. The flame, as shown in the accompanying picture, is 50 ft. long. Immediately after a team of five men arrived in the auto rescue-truck and entered the 'mine' wearing oxygen-breathing apparatus, and returned with a supposed victim. Resuscitation methods were shown outside.

From 18 states came 26 first-aid and 15 mine-rescue teams. The following teams participated: Alaska Treadwell, Alaska; Anaconda Copper, Montana; Argonaut, California; Black Oak, California; Calumet & Arizona, Arizona; Carbon Hill Coal, Washington; Champion (North Star), California; Empire, California; Folsom Morris Coal, Oklahoma, representing that State, also Arkansas, Iowa, Kansas, Missouri, and Texas; Goldfield Consolidated, Nevada; Homestake, South Dakota; Kennedy, California; Louisville Coal, West Virginia; Mammoth Copper, California; Nevada Consolidated, Nevada; North Star, California; Pacific Coast Coal, Washington; Pennsylvania Anthracite region; Plymouth, California; Ray Consoli-

TOP: COAL-MINE EXPLOSION. BOTTOM: RESCUE CORPS EMERGING FROM MINE WITH VICTIM.

dated, Arizona; Roslyn Fuel, Washington; Superior Coal, Wyoming; Tonopah Mine Operators' Association, Nevada; United States Fuel, Utah; and Utah Fuel, Utah. Medals, cups, and other prizes were donated by the California Metal Producers Association and many manufacturing firms interested in mining.

Results were as follows:

First-aid, only California teams:

Event.	Problem.	Mammoth.	Argonaut.	Empire.	Plymouth.	North Star.	Kennedy.	South Eureka.	North Star.	Black Oak.
5-man	1	98	87	90	87	91	74	87	72	87
5-man	2	84	93	79	91	74	95	86	92	79
5-man	6	98	88	96	84	97	93	86	91	83
5-man	11	94	94	96	94	94	93	92	94	93
Total points		374	362	361	356	356	355	351	349	342
Percentages		93½	90½	90¼	89	89	88¾	87¾	87¼	85½
Result		1	2	3	4	4	5	6	7	8

The problems were as follows:

(1) Four fingers of left hand severely crushed, with lacerated wound of palm of hand which is bleeding profusely; treat and carry patient 20 ft. by shoulder lift.

(2) A car has run over patient's left foot, cutting it off in front of ankle joint; severe bleeding; treat and carry patient 30 ft. by two-hand seat.

(6) Punctured wound of palm of right hand (bright red blood); small cut on calf of left leg with slight bleeding; left ankle sprained; treat case.

(11) Broken back with simple fracture of right forearm; treat and prepare for transportation.

For the first-aid inter-state elimination contest there were 22 entrants. The finals were as follows:

Event.	Problem.	Homestake.	Nevada Consol.	Bunsen Coal.	Ray Consolidated.	Alaska Treadwell.	Utah Fuel.	Pacific Coast Coal.	Louisville Coal.
1-man	5	100	100	89	93	98	95	94	100
2-man	3	100	100	95	95	96	86	93	94
3-man	3	98	98	100	93	96	100	95	95
5-man	7	98	95	96	97	93	100	96	83
5-man	6	99	100	100	100	95	93	96	100
Total points		495	493	480	478	478	474	474	472
Percentages		99	98.6	96	95.6	95.6	94.8	94.8	94.4
Result after working off ties		1	2	3	4	5	6	7	8

The Anaconda, Superior, Kennedy, and Folsom Morris teams were 9, 10, 11, and 12, with 94.4, 93.6, 88.8, and 87.8% respectively.

The problems were as follows:

(5) Man found on charged electric wire unconscious, burned on right hand and forearm; remove and treat conditions.

(3) Compound fracture of the left leg below the knee, involving both bones; prepare patient to stand transportation.

(3) Burns of head, face, neck, arms, and hands; profound shock; treat.

(7) Man overcome by after-damp, requiring immediate removal, burns on hands, arms, neck, and face; carry patient 10 ft. on an improvised litter; two of team at that time should be supposedly overcome by gas, remainder of team carry patient without a litter for 20 ft. to fresh air and treat the case.

(6) Patient found on his back across live electric wire, unconscious; rescue and give artificial respiration for one minute; then treat burns on the back and right upper arm, carry 30 ft. on any improvised stretcher except one made of poles and coats.

This, the first California first-aid meet, and the third National joint field-meet for miners was held under the auspices of the California Metal Producers Association (also financed by this organization), the National Safety Council, the U. S. Bureau of Mines, and the Mines and Metallurgy Department of the Exposition. R. U. Patterson, chief of the American Red Cross was chairman of judging the first-aid, and James Bagley, inspector from Washington was in charge of the mine-rescue judging, with R. J. Kerr as chairman of recording. Others connected with the meet were Van H. Manning, director of the U. S. Bureau of Mines; G. S. Rice, chief mining engineer of the Bureau; J. W. Paul, chief rescue engineer at Pittsburg; W. D. Ryan, safety commissioner of the Bureau; E. Steidle, at 'The Mine' at the Exposition; J. C. Roberts, engineer in charge of the Rocky Mountain district, with mine-rescue car No. 2; H. M. Wolflin, engineer for the Bureau on the Pacific Coast; and H. M. Wilson, formerly with the Bureau.

The final inter-state mine-rescue contest resulted as follows:

The problem involved the following test:

Following an explosion, the crew finds a stopping across the drift or entry, canary dead; tear hole in stopping and rescue miner, who is found unable to walk. Do not carry miner over overcast, the air just before it being good.

Each crew walked 117 yd. in two minutes, remained in smoke-room for four minutes, with apparatus, were examined by a doctor, the captain explained the tests to ensure the safety of the men, the apparatus was judged, then the work proceeded.

Event.	Problem.	Utah Fuel.	Roslyn Fuel.	Goldfield Consol.	Homestake.	Anaconda.	North Star.	Calumet & Arizona.
1	1	96	89	92	90	89	84	84
2	..	96	91	94	90	91	90	88
3	..	96	99	94	90	91	90	88
4	..	96	99	94	90	91	90	88
5	..	96	99	94	90	83	90	88
Total points		480	477	468	450	445	444	436
Percentages		96	95.4	93.6	90	89	88.8	87.2
Result		1	2	3	4	5	6	7

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LEADVILLE, COLORADO

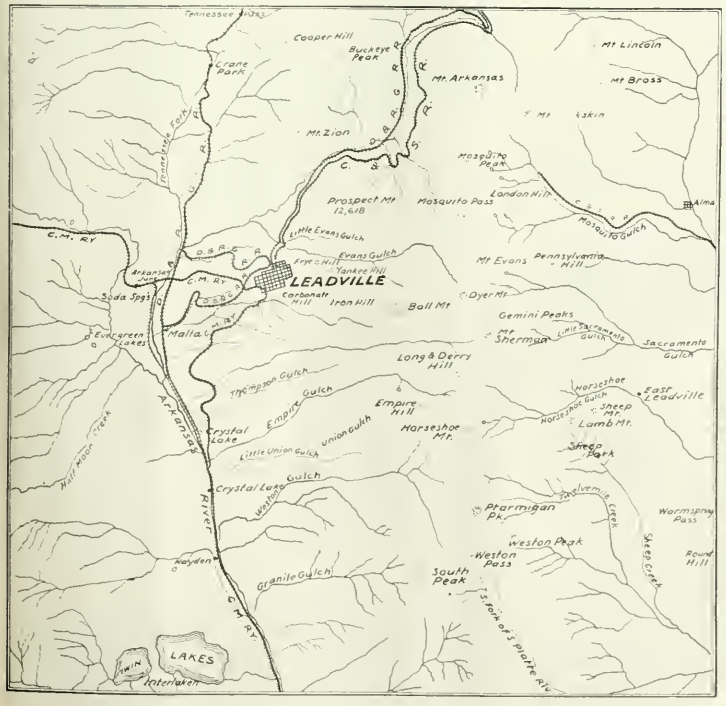
Extensive Exploration of Prospect Mountain Commenced. —Yak Tunnel to be Extended to Explore Lower Part of Mosquito Range.

Prospect mountain is the situation of another large enterprise to develop the extensive and little explored territory included in the area between Big Evans gulch and the Arkansas valley, lying at the extreme northeastern edge of the Leadville district. C. H. Weaver, F. G. Kahle, and H. A. Huttinger, of Toledo, Ohio, owners of the Buckeye zinc mine at Joplin, Missouri, have formed a company with W. B. Anderson, well known in Leadville and owner of the Anderson adit, for the purpose of continuing the work on this property. The company is completely financed as a closed corporation, with each of the above-mentioned men holding equal interests. Mr. Weaver is here in active charge of the undertaking.

The Anderson adit is situated on the northeast slope of Prospect mountain, about a mile above Birdseye, at an altitude of 10,800 ft. Mr. Anderson controls a large area there, extending from the portal of the adit over the ridge to the Big Evans side of the mountain. The opening is now 1000 ft. long, following a southeasterly direction toward Leadville, a course which is calculated to cut many of the large oreshoots that were found on this side in the valley, Silver Spoon, New Monarch, and other properties in the Big Evans territory. A number of other veins have been found from surface outcrops, and the new management expects to reach the first one within 60 days after work in the breast has been started.

The adit is one of the largest in this district, being 6 by 7½ ft. in the clear, with a 22-in. gauge track. A power-line is being erected from the Colorado Power Co.'s main near the Resurrection No. 2 in the Big Evans, directly over the ridge to the portal of the adit, a distance of about two miles. This work is being rushed, and is expected to be complete within a month. A telephone-line is being brought in to the property from Birdseye, and a road is under construction from the railroad siding near this point, over a mile of easy grade to the adit.

The adit will be equipped with modern electric machinery. The entire plant from the old Siwatch adit on Sugar Loaf, including 8000 ft. of heavy steel rails, 7 motors, 10 cars of 3½-ton capacity, air-compressors, and air pipe-line has been purchased by the new concern, and the work of moving the machinery to the Anderson adit is progressing rapidly. New surface buildings are being erected on the property, and extensive preparations are being made to put the adit in first-class working order for the winter. At the present time 20 men are employed on the preliminary work, and as soon as the machinery arrives on the ground the force will be increased. Installation of the machinery is expected to require two months. After that time the adit will be ready for extension, and three shifts will be occupied until the first large vein is cut. Men will start cross-cutting on the vein while the breast is pushed farther ahead.



THE LEADVILLE DISTRICT, COLORADO.

Prospect mountain and Mosquito range just now are attracting the interest of mining men throughout the State. With the Valley adit opening the formations of Prospect from the Leadville side, the Anderson adit coming in from the Birdseye slope, and the Yak tunnel pushing farther ahead into the foot of Mosquito range, it appears that this territory is to be the productive centre of the Leadville of the future.

The announcement of the Yak Mining, Milling & Tunnel Co., stating that the breast of the big bore will be advanced farther into the formations of lower Mosquito range,

has resulted in renewed interest in the large territory extending through the head of Big Evans gulch, Mosquito range, and Prospect mountain, where comparatively little deep mining has been done. The Yak company recently closed a large deal with the owners of the Aladdin group of claims in the Big Evans beyond the present breast of the Tunnel, as mentioned in the PRESS of September 18. The deal included an extension of 10 years on the lease which the company holds on the ground and provided a bond of $600,000 on the property to be paid within the time of the lease. The acquisition of this large tract of valuable land brought about the decision to advance the Tunnel into this ground.

Immense bodies of lead carbonate ore have been opened in the Vega property, which is part of the Aladdin group. These deposits have been worked through the Yak tunnel by means of the Diamond winze at the face of the adit. Extensive prospecting has been carried on in this ground, and the results obtained justify the advancement of the main Tunnel into the territory to a point where exploration of the ground will be greatly facilitated. The ore-shoots in this section dip away from the Tunnel to the northeast, and the future mining of the area will be at great depth. The orebodies uncovered at present are thought to be the continuation of the shoots mined in Breece hill to the southwest, and at much less depth. This ore-belt is now thought to be continuous from Breece hill through Mosquito range to the London mines in Park county.

The Yak tunnel is now a little over four miles long from the portal in California gulch through Carbonate hill, Iron hill, and Breece hill to the breast at the Diamond in Big Evans gulch. It practically traverses the entire district, and passes through the richest parts at a depth from 800 to 1400 ft. Many properties are operated through the Tunnel, and the total tonnage from the bore is the largest in the district. Gold, silver, lead, copper, and zinc ores, both oxide and sulphide, are mined by means of the Tunnel at the rate of 300 tons per day.

TORONTO, ONTARIO

SUMMARY OF OFFICIAL REPORT ON THE KOWKASH GOLDFIELD.—OPTION TAKEN ON DISCOVERY CLAIMS.—ZINC IN QUEBEC.

The assistant provincial geologist of Ontario, Percy Hopkins, who made a preliminary examination of the gold discovery at Kowkash, has forwarded his report to the provincial Bureau of Mines. The following is a résumé:

Kowkash station is 297 miles west of Cochrane on the National Transcontinental railway. The discovery is 9 miles northwest from Kowkash station, near Howard falls, on the Kawa-kash-kagama (Kowkash) river. The canoe route commences 1½ miles east of Kowkash station, and involves two short portages in a 20-mile trip. The country is of low relief, and consists of rocky hills up to 100 ft. or more in height, separated by large swamps, semi-muskegs, and sand and gravel areas. The rocky hills are covered with a dense growth of small timber and moss, and sometimes large loose boulders, which make prospecting somewhat difficult. E. W. King Dodds made his rich discovery on August 21, when walking over the rocky hill below Howard falls, which had been burned clean of moss and trees on the previous day. The news caused a rush of about 400 prospectors, and from 75 to 100 claims were staked within three weeks.

In the Kowkash area is a belt of Keewatin rocks 10 to 15 miles wide, extending from the north end of O'Sullivan (or Sesekenaga) lake in a southwest direction through Howard falls, and across the height of land at Redmond. The whole Keewatin area is worth prospecting for gold. For miles around this Keewatin belt are Laurentian granite and gneiss rocks. The Keewatin are largely massive fine-grained green chlorite and hornblende rocks, which are in places altered to schist. Some of the chlorite rock is altered diabase. Numerous exposures can be seen along the Kowkash river. Altered basalt showing the pillow or ellipsoidal structure are common, and with the basalts are small agglomerate areas. Cutting these greenstones are numerous white weathering quartz porphyry dikes up to 30 ft. or more in width. They contain numerous white quartz phenocrysts, the size of peas, in a gray to green fine-ground mass. The porphyry contains some quartz stringers, is schistose in places, and resembles the quartz-porphyry at Porcupine, Goodfish lake, and north of Schreiber. The main exposures seen extend for a mile east from Howard falls and around O'Sullivan's lake. An exposure on a large hill about two miles below Howard falls is a slate and conglomerate similar to the Timiskaming sediments in Porcupine, Kirkland Lake and Munro Township. The slate is cherty and the conglomerate pebbles consist of chert, quartz-porphyry, amygdaloidal basalt, and gneiss. Around the centre portage between Abamasagi and O'Sullivan lakes is a fine slate-like biotite and chlorite schist, which may be of sedimentary origin. At the last portage into O'Sullivan lake is an actinolite rock, below which are numerous massive serpentine exposures. A gabbro and diabase, probably the youngest rock in the area, occurs about 300 yd. north of the Dodds gold discovery. Dikes a foot thick also cut the basalt on the Dodds claim, the vein on which is ⅝ of a mile below Howard falls, and 800 ft. north of the river. The vein strikes 8° south of east and appears to dip 75 or 80° to the north, conforming in strike and dip with the country rock. The vein is somewhat lenticular, is up to 4 to 5 in. wide, and can be traced about 40 ft. ending in drift on either end. The quartz is glassy and free from sulphides. Specimen ore was seen in place over an area about 5 in. long and one inch wide, extending along the hanging-wall side of the vein. Similar and richer specimens were reported to have been taken from the 4 or 5 ft. adjacent to the above shoot. On the hanging-wall side of the vein is a rusty schist band 6 in. wide, heavily mineralized with fine pyrite. The wall rock is pillow lava (basalt), which is altered to schist in places. A mineralized quartz-porphyry dike occurs about a chain southeast of the discovery. The report concludes as follows: "The geological formation of the Kowkash district is somewhat similar to that of the Big Duck lake area north of Schreiber, 100 miles south, Goodfish lake, (Morissette Township) and Tisdale Township in the Porcupine gold area. Numerous small glassy quartz veins, some of which are mineralized with pyrite, occur over the whole area, the Dodds vein containing a very spectacular gold showing. This would suggest the advisability of a thorough prospecting of the Keewatin area."

The timber is mostly second growth, most of which has been recently burned. The trees consist of small spruce, poplar, Balm of Gilead, pine, birch, and cedar, some along the river attaining a diameter of two feet. There is some good agricultural land. Whitefish, pickerel, pike, suckers, and brook trout up to two feet long are plentiful in the Kowkash river. The Howard falls are formed by a ridge of chloritic hornblende-schist, through which the river cuts, making a narrow canyon-like gorge 14 chains long. This gorge is from 20 to 30 ft. deep, and the water descends in steps and slides varying from one to five feet. The falls are suitable for power purposes.

A Canadian-American syndicate, headed by John L. Orn, of Buffalo, and C. M. Forbes of Lanark, Ontario, has taken a working option on the three King Dodds claims at Kowkash. Work will be started as soon as possible. The price of the option is said to be a good one. Two payments have been made. About $10,000 is to be spent in development in the next four months.

An important discovery of zinc ore is reported to have been made by Dennis Callahan, a prospector of Haileybury, Ontario, near Burbridge lake in the upper Gatineau district, Quebec, about 70 miles north of Ottawa. John D. Macfarlane, mining engineer, has left Ottawa to investigate the reported find. He is familiar with the locality, and thinks that large deposits of zinc may occur there.

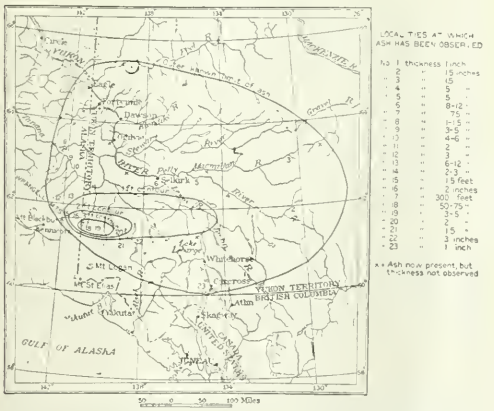
THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

The Development number of *The Alaska Daily Empire* at Juneau consists of 40 pages covering the activities of the Territory. The governor, J. F. A. Strong, contributes a page on resources and possibilities. Following this are illustrated write-ups of the commerce, Juneau (accompanied by a large photograph), banking institutions, Juneau gold belt, fisheries, scenery, power projects, mines on Douglas island, Prince of Wales island, Douglas, land laws, Prince William sound, hunting, sport, library at Juneau, agriculture, religion, and statistics.

In Professional Paper 95-D of the U. S. Geological Survey, Stephen R. Capps discusses an ancient volcanic eruption in the upper Yukon basin. A large area of Alaska and Yukon Territory is covered by a layer of volcanic ash. This ash lies beneath a thin coating of soil or silt, and in terms of geologic history the eruption is very recent, though antedating historic



MAP OF UPPER YUKON BASIN, ALASKA AND YUKON TERRITORY, SHOWING DISTRIBUTION OF VOLCANIC ASH.

record in this part of the world. Several geologists have investigated the ash deposit. It usually appears along the cut banks of rivers, is persistent, and in places is continuously exposed for miles. The ash bears a close relation to the present surface of the country. The White Pass and Yukon route to the navigable waters of the Yukon basin follows the ash-covered area. Volcanoes in the Mt. Wrangell group were thought to be the source of the ash, but it is now considered that the material was ejected from some crater near the northern border of the St. Elias mountains, near the international boundary, probably from a vent four miles north-northeast of Mt. Natazhat. The wind at the time was blowing from the west and south, and about 140,000 square miles was covered with ash.

JUNEAU

During August the Alaska Mexican mine produced $33,282 from 19,075 tons of ore. The estimated net profit, after deducting $3515 for construction, was $4957.——The Alaska Treadwell yielded $153,668 from 79,650 tons. The profit was $28,933, $22,308 being the cost of construction.

ARIZONA

COCHISE COUNTY

The Shattuck-Arizona company reports that development during August totaled 1844 ft., nearly all of which was in good copper ore.

GILA COUNTY

The Laurel Canyon Mining Co., operating 25 miles south of Fort Thomas, is planning a 300-ton concentrating plant to treat lead ore. Present shipments are 12 tons of concentrate daily. L. E. Wightman is a director.

GREENLEE COUNTY

The general managers of the Arizona, Detroit, and Shannon copper companies, N. Carmichael, M. McLean, and J. W. Bennie respectively, have addressed a communication to their employees who are on strike, dealing with the situation. Committees of the men must be appointed to meet the companies, but recognition of the Western Federation of Miners must not be a demand of the men.

Later news from Clifton shows that on the advice of C. F. Moyer, president of the Western Federation of Miners, the Morenci strikers waived their demand for recognition of the Federation; Clifton and Metcalf men did likewise. The wages are said to be lower than any copper centres of Arizona, but the labor is said to be less efficient than at the other places, 85% being Mexicans. Wages paid to miners in three districts compare as follows:

Price of copper	Globe Cents per hour	Clifton-Morenci Cents per hour
14 cents per pound	47	*32½
15 " " "	*47	33½
16 " " "	49	34½
17 " " "	50	35½
18 " " "	52	36½
19 " " "	†53	†37½

*Minimum. †Maximum.

CALIFORNIA

Oil production of this State in August totaled 7,680,047 bbl., a small decrease compared with July. Shipments from the fields amounted to 8,077,586 bbl., a large increase over the previous month, and the first month since July 1914 that the total was over 8,000,000 bbl. The Independent Oil Producers Agency reports that 6153 wells were producing oil in August; the Standard Oil Co. gives 6501 wells.

The iron ores of California and possibilities of smelting is discussed by Charles Colcock Jones of Los Angeles in Bulletin 104 of the A. I. M. E. There is no production of pig-iron west of Pueblo, Colorado, and from Canada to Mexico, the area comprising the inter-Mountain and Pacific Coast region, excepting a small quantity made by an electric smelter at Heroult, Shasta county, California. The author estimates that there is 200,000,000 tons of high-grade iron ore, and twice that amount of probable ore in southern California. The three most practically available deposits are at Eagle mountain, Cave canyon, and Providence mountain, in San Bernardino county, containing about 125,000,000 tons. The ores are 4 to 10% richer than the standard Lake Superior iron ores, and are suitable for reduction by smelting. Consumption of pig-iron on the Pacific coast is about 100,000 tons per year, and steel an additional 823,000 tons. The cost of mining these deposits would be low, esti-

mated at 85c. per ton. Transport and mining charges would be about $3.19 per ton of pig iron, Bessemer grade, against $8.05 for Lake Superior ores. Alaskan, Washington, or Utah coke could be used in smelting iron ore in California. Ample deposits of limestone are available to railroads entering Los Angeles. The principal iron deposits of southern California are of the contact-replacement type, formed at or near the contact of an intrusive igneous mass with sedimentary strata, usually limestones.

AMADOR COUNTY

It is reported that the Original Amador company is preparing plans to double the capacity of its mill at Amador City.

At the Keystone mine 80 men are employed under C. R. Downs. Forty stamps are crushing ore.——Near Pine Grove a rich shoot has been cut in the Pine Grove property. R. Robinson is in charge.

BUTTE COUNTY

With 25 men, J. Reese of Salt Lake City is re-opening the Gold Bank mine at Forbestown. It has been closed for some years.

The Undine gravel mine, 15 miles from Chico on Butte creek, has been acquired by D. S. Nesmith of Boston and San Diego. ——Oroville people have leased the Butterfly mine in Morris ravine. A new adit will be driven.

ELDORADO COUNTY

The oldest five-stamp mill in the State continues its work at the Morey mine, northwest of Grizzly Flats. It has been running since 1868, driven by water power.——The old Mt. Pleasant mine near the same place is being unwatered.——Development and mining of the limestone deposits southeast of Placerville is probable. The Southern Pacific company is surveying a line in the vicinity. The deposits are bonded to the California Portland Cement Co.

The old Mount Pleasant mine near Grizzly Flat is being unwatered. It is 1100 ft. deep, but little work has been done below 600 feet.

NEVADA COUNTY

At Nevada City a petition has been prepared asking John E. Raker, member of Congress, to use his influence in getting about $150,000 to construct a dam on the Bear river to enable hydraulicking to be resumed at Dutch Flat, You Bet, Lowell, Quaker, and Liberty hills. This is expected to add materially to the gold output of the region.

Litigation between the Empire and Golden Center companies at Grass Valley has been avoided by an agreement whereby the latter can work all veins apexing west of Auburn street, between Main street and the south boundary of the city; and no limits on the west boundary. The Empire can work all veins that apex east of Auburn street. Some cash is included in the arrangement.

The 'specimen boss' at the Empire mine, who stole ore worth over $40,000, was sentenced to four years' imprisonment.

PLACER COUNTY

The Gray Eagle Canyon placer claims have been sold by W. F. Russell of Boston to C. L. Austin and A. Fitch of Utah, for $14,800. The property is between Auburn and Forest Hill.—— The J. L. Gould property at Dutch Flat is being surveyed. A 2200-ft. adit has been driven.

PLUMAS COUNTY

The Engels Copper Co. is surveying for a narrow-gauge railway from the mine down Indian valley and Indian Creek canyon to the Western Pacific line at Keddie. The Great Western company's power-line has been connected with the property.

The U. S. Exploration Co. is to re-open the Robinson mine at Granite Basin, near the Butte County line, in charge of C. N. Miller. The old 20 stamps are to be replaced by a Sears-Smith mill. Bunk-houses are being built. From four to six miles of road will be constructed in the spring. The Butte and Plumas railway may resume operations as a result of this new work.

SIERRA COUNTY

The Tightner mine continues to supply its mill with good ore.—The Croesus 15-stamp mill is working at the Plumbago gold mine.——Development continues at the Eldorado, Gold King, Golden Fraction, Twenty-One, and other mines.

TRINITY COUNTY

Ten miles east of Weaverville, D. B. Fields and Meckle Bros. have discovered an extensive lode on Mt. Bally.

COLORADO

The Colorado Fuel & Iron Co. reports as follows for its past financial year, compared with other periods:

	1915	1914	1913
Coal mined, tons	2,329,069	2,428,992	4,091,667
Coke made, tons	520,261	535,274	784,627
Iron ore mined, tons	441,026	614,039	853,878
Limestone mined, tons	344,033	376,226	485,756
Pig iron made, tons	286,661	268,883	.....
Finished iron and steel, tons	324,600	352,929	458,521

Most of the iron ore comes from New Mexico.

DOLORES COUNTY

Salt Lake City men recently acquired the Argentine and Blackhawk mines at Rico, and among the extensive development proposed is an adit to cut the known veins at depth. These mines have a long and interesting history.

GILPIN COUNTY

The Pittsburg mine continues to produce rich gold-silver-copper ore, which is treated at the Iron City mill.——A 10-stamp mill is to be erected at the Bates mine at Mountain City by W. S. Smith. This plant will be moved from the Winnebago mine. Concentrate from ore mined from the Bates was settled for at 9.75 oz. gold, 9.25 oz. silver, and 12% lead for the first-class material.——The Ingalls Leasing Co. has made a test shipment to the U. P. R. mill.——Miners have been visiting the Nederland tungsten mines with a view to leasing.

LAKE COUNTY (LEADVILLE)

Water in the Penrose shaft is down 570 ft. At 600 ft. is the old station on which was the pumping plant of the Home Mining Co.——An electric pump has been installed in the Monarch shaft, which has been sunk from 575 to 725 ft. this summer. This mine produces 800 tons of gold, silver, lead, and zinc ores per month, on company and lessees' account.—— Zinc tailing from the old Adams mill in Strayhorse gulch is being treated at the Leadville district mill, where flotation is used.——The Star mine is sending 100 tons of iron-manganese ore per day to the steel works at Pueblo.

SAN JUAN COUNTY

The region contiguous to Silverton continues to be busy and increase the quantity of ore shipped. Prospectors are making use of the season available. Encouraging results are reported from the Sunnyside, Ledge, Columbus, and Gold King mines and mills.

IDAHO

BOISE COUNTY

(Special Correspondence.)—After being quiet for many years gold mining in Boise basin is showing renewed activity. The Diana Mines Co. was incorporated at Boise last week with a capital of $2,000,000. Nearly all of the stock is in the name of Frank T. Day of Colorado. Buffalo and Boise people are also interested, J. A. McCubbin at the latter place. A property near Placerville is to be developed and should assist work generally.

Boise, September 24.

SHOSHONE COUNTY (COEUR D'ALENE)

September dividends of Coeur d'Alene companies totaled $673,736. The Interstate-Callahan and Stewart disbursements were for the quarter.

According to Stanly A. Easton, manager of the Bunker Hill & Sullivan, the company is to erect a smelter near Kellogg, if easements are obtainable from land owners that will secure immunity from damage suits for fume from the plant. Custom ores may be treated also. So much ore is being carried on the Murray branch of the O.-W. R. & N. line that the service is to be extended.

The Hecla Mining Co. of Burke has distributed 7c. per share, or $70,000, for September. This year's total is $325,000, and $2,315,000 to date.——At the Guelph property a shaft is being sunk to 700 ft. depth. A hoist and compressor is being installed.——The Coeur d'Alene Development Co. has secured an option on eight claims of the Wonder of Pine Creek company in the Pine Creek district, for $10,000. The property is three miles west of the Bunker Hill & Sullivan. About 10,000 ft. of diamond-drilling is to be done.

MISSOURI

Jasper County

Several new mills were started in the Joplin district last week. At the Gartung tailing plant on the Emma Gordon land at Miami, Oklahoma, there are no cleaner jigs; two 'roughers' are used instead and no recovery of concentrate is made from either rougher, all 'chats' being ground and passed over a series of tables.

MONTANA

Silverbow County

The vein cut at 2500 ft. in the Davis-Daly has been opened for 60 ft., showing 10 to 12 ft. of 8% copper ore. In the middle is 3 ft. of copper glance. Stoping is to be commenced.

NEVADA

In Bulletin 620-D of the U. S. Geological Survey 'Some Cinnabar Deposits in Western Nevada' are discussed by Adolph Knopf. A belt of these deposits is situated in the heart of the Pilot mountains, eight miles direct south of east of Mina, Esmeralda county. The average altitude is 7300 ft., 2700 ft. above Mina, the supply point. The ore was discovered in June 1913 by T. Pepper and C. Keough. Not much development has been done so far. Six miles east of Beatty, Nye county, is the Fluorine quicksilver district. After a lot of extravagant estimates were published about the area little has been done. An adit was put in 1100 ft. to open $22,000,000 of ore, but none was found.

Clark County

(Special Correspondence.)—The Big Casino Mining Co., owned by Philadelphia people, consists of a large copper-gold area four miles east of Searchlight. The group is situated within 10 miles of the Colorado river, and almost 3000 ft. above it in a low range of mountains that have been capped by a lava-flow. The main shaft is down 400 ft. The deepest workings show considerable chalcopyrite with galena and some zinc-blende. A small experimental concentrating-plant has been erected. Results show a high-grade gold concentrate, also high in copper, lead, and zinc. The zone in which the ore occurs has a width of 250 ft. It consists of an altered andesite, the enclosing country rock being granite-porphyry.

The president of the Big Casino Mining Co., J. F. B. Pascoe, recently made an examination of its property with a view of starting development on a much larger scale than heretofore.

The Colorado-Nevada company's new 80-ton cyanide-plant at El Dorado canyon is working continuously under the management of G. A. Duncan of Denver.

The Duplex Mining Co. has lately shipped several cars of first-class ore to smelters at Salt Lake City, but is now closing down with a view of installing its mill before further development.

The W. Black lease at the Quartette mine is shipping regularly to Utah smelters, and also treating considerable free gold ore at the Cyrus Noble mill. The Quartette tailing-dump will soon have a $30,000 cyanide-plant erected thereon for its treatment. It is owned by B. F. Miller, Jr.

Searchlight, September 17.

Esmeralda County

The final report of the Goldfield Consolidated for August states that the net profit from 32,100 tons of ore was $106,624. Costs amounted to $4.86 per ton. Development totaled 3291 ft. at a cost of $5.06 per foot; this work revealed nothing of great importance. Lessees produced 992 tons of ore worth $23,085, of which the company received $11,795, less transport and treatment charges.

At the Jumbo Extension No. 2 shaft is down 500 ft., on its way to the 1017-ft. level. Ventilation will be improved when it connects with the 790 and 873-ft. levels. Ore shipments amount to 80 tons per day, averaging $45 per ton.

The new head-frame at the Florence is complete. Development continues on the usual plan. About 300 tons of ore was extracted in September, mostly from stopes on the new vein above 250 feet.

Humboldt County

(Special Correspondence.)—The De Lorme interests in the Lincoln Hill Milling & Mining Co. have been purchased by G. S. Johnson, who has been elected president. The property is equipped with an air-compressor and machine-drills, and a two-stamp Hendy mill. It is producing about $5000 gold per month, the ore averaging $150 per ton. Extensive development is proposed.——The Friedman adit of the Rochester Mines Co. is in 1000 ft., and should soon reach the first vein at a depth of about 1100 ft., 600 ft. below the deepest workings. Two winzes are being sunk from the 300-ft. level on a vein averaging 5 ft. thick assaying $25 per ton, of which $9 to $12 is gold. The mill is treating 120 tons a day of $15 ore.——The mill building for the Nevada Packard cyanide-plant is completed, and the machinery is being installed. The plant will be finished early in November, and will treat 75 tons per day.

Rochester, September 25.

At the Jack mine, 24 miles northeast of Golconda, ore containing 18% molybdenum has been opened. A 100-ft. incline shaft has been sunk, and 400 ft. of driving.

Lincoln County

The new mill at the Yuba Leasing & Development Co. at Pioche is ready for work, being erected in 60 days. From a 500-ton bin the ore is crushed by a 9 by 15-in. jaw crusher, reduced wet in a Marcy ball-mill, concentrated on Wilfley tables (concentrate is shipped to smelters), and then treated by cyanide in the Trent apparatus. The plant is driven by a 100-hp. gasoline engine.

Mineral County

The Rand district continues to excite attention, and incidentally some booming.——A recent shipment from the Golden Pen averaged $1000 per ton for the 45 tons. Over 300 tons of similar ore has been opened. No. 2 stope shows 18 in. of over $500 ore. A deal is pending for the sale of this mine.——The Queen Regent Merger has erected a hoist. Two shifts are sinking to 500 ft. No. 2 shaft has produced 300 tons of shipping ore, and has opened good milling ore. Other properties are developing well. The main country rock is rhyolite.

Nye County

During the week ended September 25 five mines at Tonopah and lessees produced 9629 tons of ore valued at $199,282. The Belmont, Extension, and Tonopah companies shipped a total of $210,000 of silver. There is nothing of importance to report from the mines and mills. The smaller properties continue their exploration, the Umatilla-Tonopah diamond-drill being down 1600 feet.

Sluicing at Round Mountain ceased on September 1; it will be resumed next March. Bedrock and sluice-boxes are now being cleaned up. The gravel averaged $2 per cu. yd. At 700 ft. in the mine a cross-cut has passed through 5 ft. of $50 ore. This is the Los Gazabo vein.

OKLAHOMA

Ottawa County

It is again proposed to erect a storehouse in the Miami zinc district to store concentrate. In discussing the project a prominent mining man said,

"An accumulation of concentrate in regular warehouses would necessitate future sales and take from the market much of the sharp fluctuation produced by solely cash sales. The future selling of accumulated material of standard grades would make it possible for anyone, anywhere, to purchase such product quickly and cheaply through brokerage firms instead of as at present or by representatives. At the present time prices can drop to a low figure with nothing to arrest the decline, but under the warehouse system a low-water mark could be established below which the price of ore could not drop. The warehouse receipt would also be the best possible collateral security and the holder would be able to borrow call money at any time at a reasonable rate of interest, thus being able to meet operating expenses and be able to sell to the best advantage instead of glutting an already weak market."

TEXAS

El Paso County

(Special Correspondence.)—Mining operations in Mexico must be greater than for several months past considering the large increase in the exports of ores and bullion from that country to the United States during September. Besides the shipments that were made through El Paso, considerable imports came through Eagle Pass and other border ports of entry. Receipts for the month through El Paso include 16,000 bars of lead that were imported by the American Smelting & Refining Co., consigned to its refinery at Perth Amboy, New Jersey; 13 cars of miscellaneous ores, imported by the Kansas City Consolidated Smelting & Refining Co.; 30,000 bars of lead and three cars of bullion, imported by the Balbach Smelting & Refining Co.; 27 cars of zinc ore, imported by the United States Zinc Co. of Sands Springs, Oklahoma, and four cars of zinc ore, imported by the National Zinc Co. of Bartlesville, Oklahoma.

Many of the American and Mexican mining companies in the different districts of the interior of Chihuahua and Durango have resumed operations after a long period of inactivity. The situation in the mining districts of the States of Jalisco, Guanajuato, and Zacatecas is much improved compared with that of a month or so ago, according to reports received here.

El Paso, September 25.

UTAH

Salt Lake County

At a meeting of the Wasatch Mines Co. held at Salt Lake City last week it was decided to erect an aerial tramway from the Little Cottonwood district to the terminus of the Salt Lake & Alta railroad. A 4000-ft. drainage-adit, costing $60,000, will be driven. Other operating companies were at the meeting, and it is probable that a joint company will be formed to look after these projects. C. H. Cowie, C. H. Gibbs, and J. E. Beveridge are connected with the Wasatch company. The two schemes will cost $200,000. The tram will have a capacity of 500 tons per 24 hours, and will begin near the portal of the proposed drainage-adit near the South Hecla property, and will traverse the Wasatch Mines ground to the portal of the Howland, or what is also known as the Columbus Extension adit. Near that point loading-stations will be built, and ore at present being transported by the Michigan-Utah aerial tram will be automatically loaded on the new tram which will extend from that point on down to Wasatch, the terminus of the Salt Lake & Alta railroad.

High-grade copper ore has been cut in the Albion mine where the fatality occurred two weeks ago. An air-pipe is being laid. Water is receding.

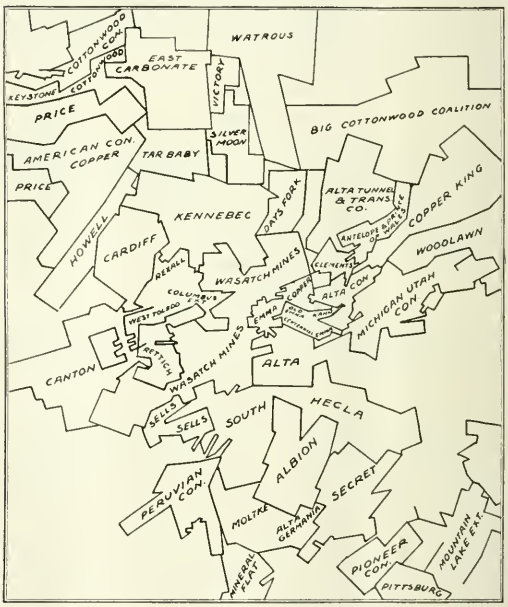
The South Hecla mine is yielding 80 tons of ore per day worth from $12 to $30 per ton.

At 600 ft. depth in the Alta Tiger 18 in. of high-grade silver-lead-copper ore was cut last week.

At the top of No. 1 raise in the Sells mine there is three feet of ore, while other parts of the property are developing satisfactorily.

The Alta Consolidated company is preparing to ship ore.

The Alta Cottonwood Railway Co. has been organized with a capital of $100,000 to construct a line into the Little Cottonwood district from the Salt Lake & Alta railroad. The new line will work on the cog system, will have snow-sheds, will



THE COTTONWOOD DISTRICT, UTAH.

charge $1 per ton for freight, and will be equipped for 1000 tons per day.

The Koehring cyanide process has been tried at the Wasatch-Utah Mining Co.'s mill near the mouth of Little Cottonwood canyon.

The Bingham-New Haven company is suing the Utah Metal & Tunnel Co. alleging that the latter has extracted ore worth $100,000 from the Levant lode, the apex of which is claimed by the complainant.

WASHINGTON

King County

The mineral deposits of the Skykomish basin are described in the Columbia University *School of Mines Quarterly* by Warren S. Smith. It is part of a report prepared for the Washington State Geological Survey, but not heretofore published. Work in the Berlin district dates back to 1892. The Apex and Cleopatra were about the first claims located in that year, the former sending out $80,000 of ore on horseback before the wagon-road was made in 1901. Early shipments from the Cleopatra yielded $132 per ton. A number of properties on Money creek reached the height of their activities between 1900 and 1905. A great deal of work, mostly as adits, was done at great expence with little result, the exploration not being judiciously planned. At the present time little is under way, although some optimism prevails. The ore minerals are

chiefly original sulphides, such as arseno-pyrite, pyrite, sphalerite, chalcopyrite, and galena. Treatment is difficult, smelting being the only successful method. Free-milling ore does not exist. The sulphides are very fine, and ordinary water concentration does not give good results.

KITTITAS COUNTY

(Special Correspondence.)—Considerable excitement exists here owing to a recent discovery on the Silvanite quartz claim, which is situated north of here on Iron creek. The vein, which is from 8 to 20 ft. wide, yielded assays from $7 to $160 gold per ton. The owners are Brooks, Heidluff, and Maxfield of Seattle. It has been known for some years that several large lodes existed up on the Swauk, prospecting and development was done at different times, and assays have given 80c. to $80 per ton. The owners have had a mill test and analysis made of their ore, and find that it contains sylvanite, a telluride of gold. The company will employ about 18 men. It is erecting a bunkhouse, etc. A shaft and cross-cut adit has been started. This is very important to the Swauk district, as the main interest has been centred in placer mining. There are many large low-grade lodes and dikes that will probably be investigated.

The Home Rule placer shipped 26 oz. of gold dust to the U. S. Assay Office at Seattle this week. H. D. Harkness is the owner of this property.——H. M. Mumford has taken a lease on the Vendetta placer claims on Lions gulch, owned by Powers & Sugars.

Liberty, September 11.

CANADA

BRITISH COLUMBIA

The Rambler-Cariboo Mining Co. will pay 1c. per share, equal to $17,500, on October 15. This is the first dividend for some time. Another similar sum will be paid in December. The mine is at Three Forks, and produces lead-silver and zinc ores.

ONTARIO

The output of metalliferous mines and works of Ontario for the six months ended June 30, as reported to the Ontario Bureau of Mines, is shown by the following table, which also gives the production for the corresponding period of last year:

	First half of 1915.	First half of 1914.
Gold	$3,570,072	$2,011,069
Silver	5,188,763	7,053,418
Copper	1,229,894	1,197,059
Nickel	3,393,528	2,872,843
Iron ore	288,296	118,119
Pig-iron	2,856,040	4,429,664
Cobalt	34,443	22,581
Cobalt oxide (including nickel oxide)	56,812	379,152

Porcupine produced $3,267,620 of the gold yield, and at the same rate the year will show an increase of 50% over that of 1914. Developments in all the gold areas are good. Part of the lessened output of silver is due to the low price of the metal. A feature of recent operations at Cobalt is the development of a series of rich veins by the Mining Corporation of Canada under the town. The output of nickel has never been so great as it is at the present time. Demand is insistent, and the producing companies are working their mines and smelters at full capacity. Compared with the corresponding period of 1914, the value of the copper output increased by over 2% and nickel over 18%. The quantity of ore raised was 548,579 tons, and of ore smelted 550,870 tons. The Canadian Copper Co. and the Mond Nickel Co. are the producing concerns. On account of the War the market for cobalt oxide, Europe, is closed, and the output decreased considerably.

An illustrated description of the new Kowkash goldfield is published in the *Canadian Mining Journal* of September 15. A geological reconnaissance was made for the Canadian survey in 1903-'04 by W. J. Wilson. Cobalt men left last week for the region, some with enough supplies to last through the winter.

PERSONAL

F. H. Sistermans has gone to Los Angeles.

LEON J. PEPPERBERG has returned from Texas.

D. C. BARD, of Butte, has been in British Columbia.

H. E. WEST has returned to his home at Santa Barbara.

H. H. WEBB has quite recovered from his recent accident.

BEN. S. REVETT has returned from Colorado to San Francisco.

HENRY KRUMB and F. S. SCHMIDT of Salt Lake City are in Alaska.

BEN. B. LAWRENCE is expected here from New York, by way of Spokane.

J. DAWSON HAWKINS, who has been on a holiday to Tahiti, has returned to Denver.

L. D. RICKETTS was called to Cananea by the latest development of Mexican misrule.

E. L. GRUVER passed through San Francisco on his return from Dawson to New York.

J. M. TURNBULL has been appointed Professor of Mining in the University of British Columbia.

PERCY HOPKINS, of the Ontario Bureau of Mines, has examined the gold discovery at Kowkash.

STANLY A. EASTON, manager of the Bunker Hill & Sullivan mine, has been in San Francisco this week.

R. B. LAMB has moved temporarily from Toronto to New York, where his office is at 15 Cedar street.

W. H. SHOCKLEY has been assisting the Editor of the MINING AND SCIENTIFIC PRESS during the past two months.

NICHOLAS S. PENN, of the Imperial Institute of Technology, at Tomsk, Siberia, is visiting Grass Valley, on his way back to Russia.

J. D. CONNOR, metallurgist for the Government of South Australia, is here and will investigate the leaching of copper ores in the United States.

JOHN M. BOUTWELL has finished his detailed report on the Old Dominion mine at Globe, Arizona, and passed through San Francisco on his way to Salt Lake City.

HENRY M. RIVES has resigned the secretaryship of the Nevada Industrial Insurance Commission to accept a similar position with the Nevada Mine Owners' Association. Mr. Rives was formerly with the Pittsburg Silver Peak Gold Mining Co., and a member of the Assembly from Esmeralda county at the last session of the Legislature.

Schools and Societies

The Montana section of the A. I. M. E. will meet at Butte on October 8. After the dinner the paper of J. A. Grimes and Paul Billingsley 'Preliminary Outline of Paper on Mines in the Boulder Batholith' will be read and discussed.

The August Bulletin of the School of Mines and Metallurgy of the UNIVERSITY OF MISSOURI, at Rolla, contains a paper entitled 'Comparative Tests of Piston-Drill Bits' by Professors C. R. Forks and L. M. Cummings, which is worth securing.

Dr. James Douglas, of New York, has offered $150,000 to the McGILL UNIVERSITY, Montreal, toward the cost of erecting a students' residence, and the board of governors has accepted the donation. Dr. Dougles has been tendered the honorary position of Chancellor of Queens University, Kingston, and it is understood that he will accept it.

The College of Engineering, UNIVERSITY OF ILLINOIS, at Urbana, reports the following new appointments to its staff, effective September 1: A. U. Bleininger, W. M. Hekking, C. V. Burger, L. C. Dillenback, C. S. Sale, C. S. Fazel, H. R. Fritz, F. A. Kirkpatrick, L. Y. Larson, W. A. Manuel, L. A. Mylius, B. R. Ordonez, S. F. Tenabe, R. L. Templin, and C. Weiss.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, September 30.

Antimony	35 —35¾
Electrolytic copper	18¾—19
Pig lead	4.75—5.70
Quicksilver (per flask)	$90
Spelter	17 —17¼
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	29

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, September 30.—Copper is firm owing to good exports and sales; lead is strong, prices unchanged, but an advance expected; zinc had a slight downward move.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Sept. 23	17.75	Aug. 18	16.89
" 24	17.75	" 25	16.27
" 25	17.75	Sept. 1	17.83
" 26 Sunday		" 8	17.62
" 27	18.00	" 15	17.42
" 28	18.00	" 22	17.75
" 29	18.00	" 29	17.87

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	....
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended September 11 totaled 533,907 lb. valued at $105,741. Of this, 314,635 lb. went to England. Imports amounted to 3,557,279 lb., worth $347,454. Peru sent 2,275,231; Cuba, 1,008,000; and Canada, 273,953 pounds.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept. 23	49.12	Aug. 18	47.33
" 24	49.37	" 25	47.08
" 25	49.37	Sept. 1	46.77
" 26 Sunday		" 8	48.20
" 27	49.37	" 15	48.56
" 28	49.12	" 22	48.85
" 29	49.37	" 29	49.29

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	....
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The silver market is firm. In London, according to Pixley & Abell, continued steadiness is expected, provided China does not attempt heavy sales. Exports of metal from London to India and China to September 8 were £3,348,250, against £4,508,000 in that period of 1914. Buying orders from India and the Continent have given a stronger undertone to the market.

On October 20 the Nipissing company pays 5%, making 20% for the year, equal to $1,200,000, and $13,440,000 to date. On the following day the Tonopah Mining Co. distributes 15%, or $150,000, making $13,000,000 to date.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Sept. 23	13.88	Aug. 18	12.21
" 24	14.00	" 25	11.96
" 25	14.25	Sept. 1	15.75
" 26 Sunday		" 8	14.77
" 27	14.50	" 15	13.92
" 28	14.50	" 22	13.58
" 29	14.25	" 29	14.23

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	....
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The average basis price for zinc concentrate in the Missouri-Kansas-Oklahoma region to September 25 was $76.37 per ton. Last week there were few changes. The output was as follows: 6428 tons blende, 290 tons calamine, and 1022 tons lead, averaging $71.02, $50.44, and $50.22 per ton respectively. The total value was $525,474, and $17,216,239 for 39 weeks.

The Edgar Zinc Co. has opened an office at Salt Lake City, and will buy Utah zinc ores.

Commercial spelter is divided into four grades, which have been defined by the American Society for Testing Materials as follows: (a) high-grade, not to contain over 0.07% lead, 0.03% iron, 0.05% cadmium, and be free from aluminum, the sum of lead, iron, and cadmium not to exceed 0.10%; (b) intermediate, not to contain over 0.20% lead, 0.03% iron, 0.50% cadmium, and be free from aluminum, the sum of the lead, iron, and cadmium not to exceed 0.50%; (c) brass special, not to contain over 0.75% lead, 0.04% iron, 0.75% cadmium, and be free from aluminum, the sum of the lead, iron, and cadmium not to exceed 1.2%, and (d) prime western, not to exceed 1.5% lead and 0.08% iron.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Sept. 1	95.00	Sept. 15	90.00
" 8	95.00	" 22	90.00
		" 29	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	....
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Sept. 23	4.50	Aug. 18	4.44
" 24	4.50	" 25	4.49
" 25	4.50	Sept. 1	4.87
" 26 Sunday		" 8	4.90
" 27	4.50	" 15	4.63
" 28	4.50	" 22	4.50
" 29	4.50	" 29	4.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	....
Apr.	3.86	4.23	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

One of the most interesting features of the lead industry is the smelter to be erected by the Bunker Hill & Sullivan company of Idaho.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	....
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is steady at 33 to 33.50c. per pound.

ANTIMONY

Demand has continued dormant and while the quotation for metal in bond continues at 26c., this figure might be shaded. Antimony out of stock can be had easily at 28.25c., the available grades, of course, being Chinese and Japanese.

ALUMINUM

Prompt metal has been quoted at 48.50c., but can be had at 46.50 to 47.50c. It is exceedingly scarce, and scrap is eagerly sought for at prices higher than those of new metal a few months ago.

Eastern Metal Market

New York, September 24.

The uncertainties of these war times continue to be exemplified by the metal market. Copper has been exceedingly dull, with electrolytic stronger than Lake. Exports are light. After a series of reductions, zinc took a turn upward on September 22, and again there are allegations of manipulation, but it is certain that spot and prompt spelter are not easy to obtain. Lead has been steady at the quotation of the leading interest, to which strength has been imparted by a strong tone at London. Tin dropped to 32.25c. in a stagnant market. The market is over-supplied with unsold metal, and all the indications are for a substantial increase in surplus stocks at the end of the month. Antimony has been dull, weak, and uninteresting. The scarcity of aluminum has caused the quotation for spot metal to advance to about 48c. The entire market depends considerably on the successful negotiation of the foreign loan negotiations, now near at hand, [arranged on September 28.—EDITOR], one effect of which is expected to be the restoration of foreign exchange to somewhere near its normal level. The English pound sterling was quoted yesterday at $4.71.

In iron and steel the general tendency to advance continues. Wire products are $2 per ton higher, principally because of export demand. It is expected that plates, shapes, and bars will go to 1.40c. base, Pittsburg. Several products, other than wire, are higher. The demand for steel for large sizes of explosive shells is exceedingly heavy, and calculated to make serious inroads on the supply. Foundry iron is quiet, and has not the prospect of heavy demand that faces steel-making iron. Steel is not easy to secure to-day in any form. Exports of iron and steel in July totaled 368,893 tons, against 355,829 tons in June, 114,790 tons in July, 1914; 237,159 tons in July, 1913, and 272,778 tons in July 1912.

COPPER

An interesting feature of the copper market is the unusual relation existing between Lake and electrolytic quotations. The asked-price of electrolytic is considerably firmer than that of Lake; also higher if all grades of Lake are taken into account. Despite the fact that business has been very quiet, the electrolytic quotation has continued firm at 17.75c. cash, New York, whereas Lake has been soft, and offerings of low-grade metal have been made down to 17c. cash, New York. Important producers seem to have a great deal of faith in the future, inasmuch as they continue to quote electrolytic at 18c., 30 days, delivered; but it is pointed out that with no interest shown by consumers they might as well quote 18c., as any price. Prime Lake has been sold in the past few days at 18c., but not in large quantities. The exports make a poor showing, amounting to 8823 tons up to September 24. Much speculation is rife as to the causes of the present stagnation. By some it is pointed out that pending the settlement of the foreign loan nothing but quiet can be expected; also, the rate of foreign exchange is considered. Another explanation is that the manufacture of ammunition has been slow in getting under way, and that the makers have not yet consumed the metal they bought when they booked the contracts, and still again, the incessant strikes are held accountable to some degree for the situation, inasmuch as they have at least made war contractors more or less timid. Arsenical brands of Lake are in very light demand. The optimistic side of the market is that every prolonged period of inactivity is the forerunner of a good movement when consumers do bestir themselves. The European visible supplies on August 31 amounted to 39,237 tons, against 41,716 tons on the 14th, a decrease of 2479 tons. The general opinion is that production is running ahead of deliveries, but how much is merely a matter of opinion.

ZINC

Allegations are heard again of efforts to manipulate the market; first to depress prices, then to advance them. However that may be, it is certain that the quotations for prompt metal declined until September 22, when there was a sudden and decided turn upward, the price going from 13.25 New York, to 13.75c., while on the 23rd, 13.87½ to 14c. was quoted for prime Western. On the 24th it advanced to 14.25c., New York. What activity there has been has been almost entirely confined to prompt metal and deliveries to the middle of October all of which are scarce. Consumers evidently have no incentive to make contracts. Brass-mill special was quoted this week at 16c., and high-class grades (though not the very choicest) have been quoted at 27c. The London market has been weak. The market for galvanized sheets is easier and prices somewhat irregular. No. 28-gauge are quoted at 3.45c., but some of the heavier gauges are relatively cheaper. The demand is exceeded by that for black and blue annealed sheets, which, contrary to galvanized, are strong.

Sheet zinc is quoted at 16c., f.o.b. smelter, subject to the following discounts:

	Cash with order	Quantity	Total
	%	%	%
Carloads	3	5	8
9000-pound lots	3	3	6
6000-pound lots	3	2	5
3000-pound lots	3	1	4
Less than 3000 pounds	3	.	3

Exports of spelter from September 1 to 24 amounted to 2635 tons.

LEAD

There is little to say about this metal except that while the market has been uninterruptedly dull, quotations have not been impaired appreciably. On one or two days there was a little disposition shown by second-hands to sell at slightly under 4.50c. New York, the quotation of the A. S. & R. Co. Late this week all concessions disappeared, and the market took on a firm tone, so much so that sellers were not eager to sell, and it is thought that quotations will advance. The London market has been strong, and has gained steadily. Export inquiry has shown a decided betterment, a part of it coming from Japan. The exports of the month, up to the 24th totaled 1730 tons.

TIN

Suffering from an over-supply, the tin market has declined heavily. The quotation on September 23 was 32.25c., and on the next day, 32.50c. with practically no demand, in fact, the market has been at a standstill for days. Up to the 24th the arrivals totaled 4693 tons, and there was afloat on that day 2810 tons, all of which indicates a large increase in stocks at the end of this month. On the 21st the quotation was 33c., and at that time sellers considered that business would start at 32.50c., but they feared a decline, inasmuch as it might not stop at this price, and that is just what happened. Aside from the over-supply, the foreign exchange situation is having an adverse affect on the market. In reflection of the weak condition here, spot tin in London declined £2 on September 23. Meanwhile the demand for tin-plates is slowing up. The imports of tin at Pacific ports in July aggregated 1,162,025 lb. (value $405,242) at San Francisco, and 963,789 lb. (value $335,602) at Washington.

On September 3, Henry R. Merton & Co., of London, stated that the margin between standard copper and electrolytic brands was £16 per ton, far greater than for many years. Lack of speculation and high prices of American copper are responsible.

Current Prices for Oils and Candles

(Corrected monthly by Standard Oil Co., California.)

All prices are f.o.b. San Francisco except where otherwise specified, and are subject to change without notice.

Granite Mining Candles.	Per set, cents.	Granite Mining Candles.	Per set, cents.
6s-12 oz.-40s	8¾	6s-14 oz.-40s	9¼
6s-12 oz.-20s	9	6s-14 oz.-20s	9½
6s-12 oz.-20s	8¼	6s-16 oz.-40s	10
12s-12 oz.-40s	9	6s-16 oz.-20s	10¼

Extra hard 1c. per set higher than the above.

The following prices are for oils (Calol) in wood barrels; cases (2-5 gal.) 3c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Compressor oil	40	Light gas engine oil	28
Amber gas engine oil	40	Red compressor oil	26
Castor machine oil	20	Red engine oil	17
Dynamo and motor oil	24	Turbine oil	30
Engine oil	24	Turbine oil, heavy	30
Gas engine oil	26	Diesel engine oil	30
Heavy gas engine oil	45	Cylinder oil	37
Heavy red engine oil	19	High-pressure cylinder oil	50
Heavy red journal oil	21	Low-pressure cylinder oil	37
Ice machine oil	28	Valve oil	44

The following prices are for oils in iron barrels, cases (2-5 gal.) 7c. per gallon higher, except on Eocene, which is 8c. per gallon higher.

	Per gal., cents.		Per gal., cents.
Pearl oil	9	Engine distillate	7
Headlight oil	10	Aroturps	18
Eocene oil	11	V. M. and P. Naphtha, iron bbl. or bulk	11
Red Crown gasoline, iron bbl. or bulk	12		

	Per bbl.
Calol fuel oil, f.o.b. Richmond Refinery	$0.80
	Per ton.
Petrolastic cement X (f.o.b. Richmond)	$12.00
Petrolastic cement XX	11.00
Asphaltum	$5.50 to 12.50

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked* subject immediate delivery.

	Min.	Max.
Antimony ore, 45 to 55%, per ton	*$65.00	$90.00
Arsenic, white, refined, per lb	0.04	0.05
Arsenic, red, refined, per lb	0.15	0.18
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	7.50
Asphaltum, refined, per ton	11.50	20.00
Barium chloride, commercial, per ton	80.00	120.00
Barium sulphate (barytes), prepared, per ton	20.00	30.00
Bismuth ore, 15%, per ton	*250.00	upward
China clay, English, levigated, per ton	15.00	20.00
Chrome ore, according to quality, per ton	7.50	10.00
Cobalt metal, refined, f.o.b. London, per lb	1.90	....
Coke, foundry, per 2240 lb	15.00	20.00
Diamonds (according to size and quality):		
Borts, per carat	2.00	15.00
Carbons, per carat	55.00	80.00
Feldspar, per ton	5.00	25.00
Firebrick:		
Silica, per M	58.00	65.00
Snowball, per M	45.00	50.00
Flint pebbles for tube-mills, Danish, per 2240 lb.	21.50	24.00
Fluorspar, per ton	10.00	15.00
Fuller's earth, according to quality, per ton	20.00	30.00
Gilsonite, per ton	37.50	40.00
Graphite:		
Amorphous, per lb	0.01	0.02½
Crystalline, per lb	0.04	0.13
Gypsum, per ton	5.00	7.50
Infusorial earth, per ton	10.00	15.00
Iridium	55.00	....
Magnesite, crude, per ton	5.00	7.50
Magnesite, dead calcined, per ton	20.00	25.00
Manganese ore, oxide, crude, per ton	10.00	15.00
Manganese, prepared, according to quality, per ton	50.00	75.00
Mica, according to size and quality, per lb	$0.05	$1.00
Molybdenite, 95% MoS_2, per ton	1000.00	1500.00
Monazite sand (5% thoria), per ton	150.00	200.00
Nickel, metal, refined, per lb	0.45	0.60
Ochre, extra strength, levigated, per 100 lb	2.00	3.00
Osmiridium, per oz	30.00	40.00
Platinum, native, crude, per oz	30.00	45.00
Silex lining for tube-mills, per 2240 lb	35.00	45.00
Sulphur, crude, per ton	25.00	30.00
Talc, prepared, according to quality, per ton	20.00	50.00
Tin ore, 60%, per ton	450.00	600.00
Tungsten ore, 65%	*450.00	540.00
Uranium ore, 10% min	25.00 per unit	
Vanadium ore, 15% V_2O_5, per ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, per ton	subject negotiation	

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, per 100 lb	$ 0.90	$ 1.20
Acid, sulphuric, com'l, 66°, carboy, per 100 lb	1.25	2.00
Acid, sulphuric, C. P., 9-lb. bottle, bbl., per lb.	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, per lb	0.09½	0.12
Acid, muriatic, com'l, carboy, per 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., per lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, per lb	0.10½	0.15
Acid, nitric, com'l, carboy, per 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., per lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, per lb*	0.12½	0.15
Argols, ground, bbl., per lb	0.10	0.20
Borax, cryst. and conc., bags, per 100 lb	5.25	6.15
Borax, powdered, bbl., per 100 lb	5.75	6.60
Borax glass, gd. 30 mesh, cases, tin lined, per 100 lb.	12.00	15.00
Bone ash, 60 to 80 mesh, bbl., per 100 lb	0.50	6.50
Bromine, 1-lb. bottle, per lb	0.55	0.65
Clay, domestic fire, sack, per 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, per lb	No quotes	
Cyanide, 98 to 100%, 200-lb. case, per lb	"	"
Cyanide, 129%, 100-lb. case, per lb	"	"
Cyanide, 129%, 200-lb. case, per lb	"	"
Lead acetate, brown broken, casks, per 100 lb.	9.75	12.50
Lead acetate, white broken, casks, per 100 lb	10.87	13.50
Lead acetate, white, crystals, per 100 lb	12.50	13.25
Lead, C. P., test., gran., per 100 lb	13.00	15.00
Lead, C. P., sheet, per 100 lb	15.00	18.00
Litharge, com'l, per 100 lb	8.75	9.25
Litharge, C. P., silver free, per 100 lb	13.00	15.00
Manganese ox., blk., dom. in bags, per ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, per ton (85% MnO_2—¾% Fe)	100.00	115.00
Nitre, double ref'd., small cryst., bbl., per 100 lb.	18.00	....
Nitre, double ref'd., granular, bbl., per 100 lb.	18.00	....
Nitre, double ref'd., powdered, bbl., per 100 lb.	18.00	....
Potassium bicarbonate, cryst., per 100 lb	22.00	25.00
Potassium carbonate, calcined, per 100 lb	30.00	40.00
Potassium permanganate, drum, per lb	1.10	1.25
Silica, powdered, bags, per lb	0.03	0.05
Soda, carbonate (ash), bbl., per 100 lb	1.45	1.75
Soda, bicarbonate, bbl., per 100 lb	2.00	2.50
Soda, caustic, ground, 98%, bbl., per 100 lb	5.25	....
Soda, caustic, solid, 98%, drums, per 100 lb	5.00	....
Zinc shavings, 850 fine, bbl., per 100 lb	30.00	....
Zinc sheet, No. 9—18 by 84, drum, per 100 lb	No quotes	

*Extra charge for packing nitric acid for shipment to conform to regulations.

ALUMINUM

The production of bauxite in the United States during 1914 was 219,318 tons, valued at $1,069,194, or $4.87 per ton. Alabama, Arkansas, Georgia, and Tennessee were the principal producing states. Imports amounted to 24,844 tons worth under $1 per ton. The world's output is nearly 500,000 tons per year, France leading. From this mineral the metal aluminum is reduced, at Niagara Falls, by electricity. The yield of the United States in 1914 was 79,129,000 lb., and of the world in 1913, 45,700 metric tons. Of this France produced 18,000; Austria, 12,000; England, 7500; and Canada, 5900 tons.

EDITORIAL

T. A. RICKARD - Editor

SHEET-ZINC is now quoted on our metal page. The quotation will interest those using this form of spelter in cyanide plants.

GOLD inflation and fabulous earnings by munition manufacturers suffice to explain the hysteries of Wall Street, but the danger of the gambling in war stocks is thoroughly understood and well discounted.

JOHN D. ROCKEFELLER, JR., has made himself almost popular by his informal visit to the coal mines in Colorado. Such attempts to become reasonably well informed concerning their employees should be made so frequently by the beneficiaries of big industries as to be considered normal, not eccentric.

BETHLEHEM STEEL is the product of Charles M. Schwab's organizing ability, and it is an illustration of the loyal co-operation of a small group of hard-workers. Without big salaries, but by premiums on production and on economic management, several of Mr. Schwab's junior associates have made large fortunes, to which they are fully entitled under the conditions of an industrial civilization.

OATMAN is a promising gold-mining district, as was shown in the article by Mr. Howard D. Smith published by us on July 31, but the reputation of the district will only suffer from some of the ill-considered efforts now being made to boom it. In one of our local organs of misinformation we read that Oatman "will develop a gold output of extent and value comparable with the great Rand gold belt of South Africa." The Rand produces $180,000,000 per annum. Such comparisons only render Oatman ridiculous.

ELM ORLU is the name of the mine now in litigation with the Butte & Superior. It is a corruption of ormolu, a gold-colored alloy. We understand that Mr. W. A. Clark is a large holder in both mines, but we do not presume that he is acquiescing in the expense of litigation in order to clarify the legal record. If Mr. D. C. Jackling held a large block of shares in the Elm Orlu, as well as in the Black Rock, the coincidence might suggest a friendly collusion to aid the experts, legal and geological, to whom the case will be a source of intellectual exercise and, possibly, of revenue.

A VISITOR from Oatman, Arizona, tells us the stopping of the sale of liquor has helped mining, for a number of the miners who formerly spent their money on drink have formed development companies and are sinking shafts through the rhyolite cap in search for ore. Geologically, conditions in the Oatman district are similar to those in that part of Tonopah where the veins are covered by a flow of eruptive rock. At Oatman the caprock is a rhyolite that is later than the vein-formation. The ancient surface, existing at the time of this rhyolite flow, can be traced by following the line where the rhyolite has softened the rock below it.

COPPER production is suffering to the extent of 6,000,000 pounds per month from the strike in the Clifton, Morenci, and Metcalf districts. The managers of the Arizona, Detroit, and Shannon companies have left the mines, after having refused to meet the labor leaders in conference, for the reason that the Western Federation is at the back of the trouble. Strikes, started by the same agency, failed at Miami in February and at Ray in July. The question of wages is subordinate to the attempt of a lawless coterie to dominate labor in this part of Arizona. Similar attempts in Utah, Michigan, and Montana have been made during the last two years, but they were unsuccessful.

ACCORDING to recent advices the Russian government has sanctioned the building of a railway to connect the Bodaibo goldfield with the Trans-Siberian main line. This branch will run from Tataurovaya through Barguzin and prove of great benefit to several companies, notably the Lena Goldfields. We note also that the distribution of several hundred thousands of German and Austrian prisoners of war in the interior of Siberia is going to have a great effect on the future development of the country, for many of these involuntary immigrants will never go back, having found opportunities to suit them. Thus the War may accelerate the industrial advancement of an important mineral region.

IN the *Mining Magazine* we find a reference to the interesting fact that the shareholders of the Talisman Consolidated, operating a mine in New Zealand, are proposing to remove the office and administration of the company to New Zealand, where also the control of the stock is held. This is to be done in order to avoid the high income-tax now payable in England. We happen to know that this payment of war-taxation is a little annoying, for example, to some of the California shareholders in the Plymouth Consolidated. As a matter of fact the payment of income-tax on the dividends from a mine is a glaring fiscal fallacy, because such a dividend is not income until the capital has been redeemed, and

that does not often happen when, as is usually the case, the mine is over-capitalized. But the promoters of mines, in London and elsewhere, are to blame if the tax-collector treats dividends as income, the misunderstanding having arisen from the effort to exaggerate the value of mines by labelling the profit from a wasting asset as a return on capital. Nevertheless, it is an injustice to the public, and to the industry, in so far as it mulcts the shareholders of a part of their legitimate winnings. With an income-tax at about 17%, this becomes a serious matter to shareholders, whether British or American, although the former at least will be ready to recognize the fact that mining in its world-wide aspect would be utterly paralyzed today had not the British navy kept the trade-routes open for the large majority of those engaged in overseas mining.

EARLY in September three incendiary bombs were dropped upon Salisbury House, where *The Mining Magazine* is domiciled. No serious damage was done. Another bomb fell through London Wall Buildings and several on Moorgate Street. This, the only Zeppelin raid that did any harm to London, occurred at night on September 8. The result was to kill a few inoffensive persons and to start some minor fires, besides affording plenty of work for the glaziers. The September issue of the *Magazine* shows no signs of disquiet. As many of our readers are aware, the copies of the August issue consigned for this side went down on the *Arabic*. We trust that this may prove the worst bit of ill luck to befall our London contemporary.

STATISTICS of foreign commerce reflect the remarkable developments of the past fiscal year, to the end of June, but they are not truly indicative of the big changes in progress because the depression during the early part of the fiscal period tends to obscure the growth of trade during the second half of the year. We give some of the metal statistics herewith:

		1915.	1914.
	IMPORTS		
Copper,	unmanufactured	23,208,960	19,456,588
	Manufactures	46,205,123	70,704,828
Tin	"	30,777,617	39,422,479
	EXPORTS		
Brass	"	20,544,549	7,472,476
Copper	"	99,778,177	149,479,645
Lead	"	9,044,479	2,610,207
Zinc	"	21,939,253	995,077

These show how the export of copper to Europe in preparation for the War was bigger than any trade movement since then, but the exports of brass, lead, and zinc, especially the last, have increased enormously. Of course, the brass includes a large proportion of copper.

MEXICAN AFFAIRS are simmering quietly, in expectation of the lid being raised again shortly by the Pan-American conference. The scare in the North has abated; uneasy quiet reigns through Chihuahua. Villa has damaged the railway so that Carranza cannot advance in a hurry. The American and British consuls are remaining, together with a considerable number of their respective nationals. A few mines scattered over the country are doing a little development work for the better protection of property and to keep their men from starvation. The Alvarado mine at Parral is producing enough ore to keep the mill going. The eastern side of the north country, through Monterrey and Saltillo, is now less disturbed, having passed under the control of Carranza's troops. Trains are being run with some attempt at regularity between Laredo and Saltillo, and occasionally down to San Luis Potosi and even to Aguascalientes. No attempt is being made, however, to transact business. The lack of food has been pitiful, even corn not being available. Carranza, of course, says the Red Cross need not send supplies, but gaunt famine stalks across the devastated land. The general impression at El Paso is that the present enforced idleness of the mines and smelters will last until the end of the year, at least. For the rest, the hope of restoring order out of chaos rests in the hands of the Administration at Washington and of their Pan-American coadjutators, all of whom have as yet done nothing beyond the publication of pronunciamentos, which are regarded as 'scraps of paper' by the leaders of faction in Mexico.

ACCIDENTS in mines and their causes was the subject of an acrimonious discussion at the meeting of the American Mining Congress at the session of September 22. Mr. Harry L. Day, of Wallace, Idaho, contended that two-thirds of the mine accidents were caused by the carelessness of the miners. His statements were vigorously combatted by Mr. Frederick L. Hoffman, statistician of the Prudential Insurance Company, and by Mr. Herbert M. Wilson, director of safety for the Associated Mining Companies. It is quite possible that Messrs. Hoffman and Wilson have access to statistics of which we are ignorant, but as far as our information goes it supports Mr. Day's contention. Our own personal experience is that most of the accidents in the mines we have managed have been due to the recklessness of the miner, and to his direct disobedience of rules. Tell a miner as often as you will that he should not keep fulminating caps and dynamite in the same place, and explain to him the danger of carrying dynamite and capped fuse in the same pocket with the caps perilously near his lighted candle, and yet the next time you go through the mine you will find the box of caps quietly reposing on the box of dynamite, or the miner climbing down a ladder with his waving candle within a few inches of the dangerous caps. Glancing at the summary of causes of accidents that is contained in a recent paper by Mr. W. H. Shockley, we find that the report of the Pennsylvania Department of Mines for 1913 gives the carelessness of the deceased as the cause of 61.6% of the deaths for that year. Mr. Charles W. Goodale states that 85% of the accidents at Great Falls, Montana, are due to carelessness. The Inspector of Mines for Montana also finds that "the great danger lies in the acts of ignorant and irresponsible laborers and miners who take unnecessary risks in defiance of law and common sense." We invite discussion on this important question.

Valuation of Mines

At the recent Engineering Congress the subject of valuation as applied to oil, coal, and metal mines was discussed in various papers. Of the three divisions of the subject, that relating to the precious metals and to the chief base metals, omitting iron, is the most important to our readers. It might be well to distinguish between mines of gold or silver ore, on the one hand, and mines of copper, lead, or zinc on the other, for the deposits of the precious metals have characteristics different from those of the base metals, but for the purpose of a general discussion this is not necessary, although we may agree that the distribution of gold and silver in nature in concentrations of mineral is more erratic and therefore more hazardous, from the miner's standpoint, than that of the commoner metals. Yet we must add that the increased hazard is compensated by the greater possible gain. Here we strike the key to a discussion of the subject from the business side: the recognition that in any enterprise we must take pains to ascertain whether the gain is proportioned to the risk. To make an even bet on a particular horse out of a field of a dozen horses is, if this be done systematically and often, a sure way to pauperism. To buy railroad shares on a 3% basis, when Government bonds yielding the same returns are available at the same price, is not sagacious. To appraise the common shares of the U. S. Steel Corporation on the same basis as the bonds of that corporation is manifestly foolish. Speculation in the common stock has possibilities, both up and down, of winning and losing, that are eliminated from the investing of money in the bonds. In one case it is the possible enhancement of the principal, in the other the assured dividend, that is likely to prompt a purchase.

Mining has suffered from the unwise, because untrue, idea that it affords opportunities for investment. That may be true, or not, of iron mines and coal lands; we are referring now to what are called precious-metal and base-metal mines. In consequence of the investment idea, the element of risk has been minimized so that the return expected from the use of money in mining has been put too low to be profitable in the long run. To buy Rand gold-mining shares on a 5% basis is stupid, because it ignores the dangers inseparable from the vicissitudes of that particular industry; to purchase Alaskan gold shares for a 7% return is to disregard the risk inherent in a business in which so many of the factors are both variable and uncertain; yet these are supposed to be among the least risky of mining ventures. To talk of a productive low-grade copper mine as "a manufacturing proposition" or a successful silver-lead mine as "a gilt-edged investment" is to flout all the experience of the years. Such enterprises indeed may prove to be gloriously profitable ventures and magnificently remunerative speculations, but the element of safety is absent from any business that exposes a man's money to the ineradicable hazard of adventure. The result of this mirage of unhealthy optimism, whereby the promoter sells to the public a watered stock as if it were a bond, is to hurt mining deeply. In short, we believe that by this confusion of ideas between investment and speculation, the whole finance of mining has been pitched too high; to use a musician's phrase, it has been pitched a third too high. That does not mean 33⅓%. It means that the tone of discussion, more particularly of the practical discussion that ends in appraisal, has been conducted in the wrong key, causing a falsetto that has spoiled the harmonious progress of a world-wide industry. If the risk, and the corresponding gain, of course, in mining were properly recognized, and the use of money for the purpose were adequately remunerative, not only to the few who get in on the ground-floor but to the many that take the elevator of a boom, we should see more general participation by the public and more liberal support by the community at large.

In the article on another page it is shown, we believe, that most of the published methods of appraisal are fundamentally wrong because they proceed to treat a mining venture as an investment. At the end of the measuring and sampling, of the estimating of yield and cost, of the allowances for depreciation and deductions for amortization—when the whole of this deeply serious performance is ended—the engineer has to face the question as to what percentage of profit is required to make the venture a sound business. He must consider the risk involved in the search for ore in a particular district and the hazard inherent to the winning of a metal of changing market-value. And then he must estimate the risk involved in the particular mine and its management. Just as the same engineer, if he were to become the agent of an insurance company, would have to consider the average longevity of man, the average longevity of persons residing in a particular country or pursuing a particular vocation, and in the end he would have to estimate the risk involved in the insuring of the man before him. Of course, he would have all history to guide him, he would have actuarial records to help him, he would have the facts concerning the family, more particularly the parents, of the subject of his investigation; he would have a vast array of systematized knowledge at his service. What has the engineer? The cumulative knowledge on the duration of mines is not 50 years old; in some kinds of mining it does not cover 25 years. The stories of only a few mines have been placed on record, and those relate to the exceptionally profitable and persistent. Such knowledge as lies scattered in the minds of experienced men is not available for general use; all that we get are scraps of information. The bulk of the valuable experience dies with the individual, because it is of the kind that the exigencies of a professional career render unsuitable or undesirable for publication. To change the analogy: the engineer is like a physician who has seen only a few post-mortems, and for that reason is an unsafe diagnostician. What is needed, in order to lessen the insecurity of mining as a business, is last year's almanac, in adequate detail: a record of the estimates made on mines and a statement showing how those estimates stood the test of subsequent events. We need a collection of reports by the best hundred engineers in

the profession during the last 50 years, together with the history of the mines during the five or ten years after the dates of the respective reports. In this way we would get the data by which to determine the risk involved in the use of money for mining, and thus we should arrive intelligently at the percentage of profit required to justify the employment of capital in such operations. That would be a scientific approach to the solution of a great problem. When we had done it, we could not fail to be impressed by the folly of appraising mines on an investment basis; we would learn that mining is essentially speculative; we would conclude confidently that when pursued sanely, the gain more than compensates for the risk, so that in the end the sagacious speculation may be more profitable than the timid investment.

The Teaching of Mining

On another page we publish an article on 'What Constitutes a Mining College.' It is written by an engineer so lately graduated as to be in touch with the present methods of teaching and yet sufficiently long in the arena of life to be able to appraise the effectiveness of that teaching. We get the views of professors on this subject often enough; it is well to hear from their victims or beneficiaries. Undoubtedly the number of institutions organized to teach mining is excessive; every little provincial university nowadays seems to think it proper to include a course in mining in its heterogeneous curriculum. Even in States where the average citizen can hardly distinguish a mine from a submarine, the attempt is made to teach the youthful farmer how to dig holes beyond his depth. In other localities, within sight of a head-frame and within hearing of the cheerful whistle that marks the arrival and departure of those that go down in skips, it does seem unwise to try to teach a most difficult subject unless it can be done with some approach to thoroughness. At the present time, we know that several mining schools are languishing both for lack of capable teachers and of the financial support that not unnaturally is proportioned to the number of students, as indicating the apparent demand for a special course of instruction. On the whole, we think it is easier to find the students than the teacher, and for that reason, among others, we deem it a pity to see so many half-baked efforts at the maintenance of a school of mining. Indeed, the lack of good teachers of a subject so difficult to teach—because it is essentially practical and empirical—is the main objection to the multiplicity of courses in mining. In some institutions of academic distinction it appears to have been assumed that the erection of a marble mausoleum to the memory of a deceased plutocrat or the construction of a granite museum to the honor of a late philanthropist suffices to make a school of mines. On the whole, we think that in a country so rich and generous as the United States it is easier to get the money for resplendent buildings than to find the men to convert those buildings into something more than mere sarcophagi of knowledge. Out of the many men made depressingly rich by the boom in war-stocks there ought to be one willing to endow a department of mining generously on condition that an amount no larger than the annual salary of the professoriate be spent on the building and its adjuncts; in short, we would like to see a department of mining endowed so that the professor could have ample opportunity to travel and gather information, and be released, in his turn, for at least three months every year, from any contact with the students: in other words, provided with the chance to absorb new impressions and fresh facts, as against the nine months when the professors are giving out freely from their store of knowledge and experience.

In the article by Mr. McDonald it is said that the essentials of the real mining college are two, the first of which is "location and equipment." Certainly, a school of mining should be either where there is population or where there is mining, as a smelter is established either where ore is plentiful or where fuel is cheap. For a purely mining school the neighborhood of a mining district is preferable; for a university in which mining is only a department, a centre of population is desirable. We do not consider the vicinity of mines essential, if the students use their long vacation to see something of the realities of the work for which they are preparing. To understand mining a man must first understand many other things, he must have a foundation of scientific principles, which are taught best in a university or a technical college, such as rarely exists near the mines themselves. But this is a minor point, it is the second that is all-important, namely, the personnel of the professors and instructors, the tone of the school as given by its president and faculty, the spirit animating the student-body. To learn anything, even Greek or biology, thoroughly from a great teacher is more educative to an earnest student than to listen to the daily maunderings of a small mind; to come under the influence of a character-making man like Huxley, Le Conte, or Shaler is more to a young man than all the lectures of a petty personality. As Shalers and Le Contes are rare, it behooves us not to over-work them with departmental and routine duties when they are available for the greater work in hand. In these days, the teacher in a big school of mines is burdened with a lot of trivial tasks that undermine his physical strength to an extent not appreciated until it is too late. We have in mind one teacher, beloved of his students, who has given to red tape what was meant for mankind; until the high sense of duty has resulted in a mental fatigue from which recovery is not easy. Such a teacher is worth more than a marble hall, and impresses a generation of young men more than all the apparatus that was ever furnished to a mining school. Have we digressed from our subject? No. The teaching of mining, with which we associate metallurgy and geology, is a matter of character and personality more than multiplicity of schools or magnitude of college buildings. An institution is the lengthened shadow of a man.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Surface Tension

The Editor:

Sir—In your editorial on 'Flotation at Broken Hill' in your issue of September 4, 1915, page 343, you made a statement regarding surface tension that is rather befogging to a student of flotation. It is as follows: "Mr. Hebbard says that the surface tension was increased by the salts introduced, but, we venture to suggest that the opposite was the fact."

Surface tension has been threshed out pretty thoroughly by articles appearing in the Journals of the Ameriean Chemical Society, beginning in 1908.

Jour.	Am.	Chem.	Soc.,	Vol.	XXX,	No.	3,	March	1908
"	"	"	"	"	"	"	7,	July	1908
"	"	"	"	"	XXXIII,	"	3,	March	1911
"	"	"	"	"	"	"	5,	May	1911
"	"	"	"	"	"	"	7,	July	1911
"	"	"	"	"	XXXV,	"	10,	October	1913
"	"	"	"	"	"	"	11,	November	1913
"	"	"	"	"	"	"	12,	December	1913

These articles deal with the drop-weight method (weight of a falling drop) for the determination of molecular weight, critical temperature, and surface tension, and they describe the apparatus used. The work was started by Morgan and Stevens, who wished to investigate what had become known as the law of Tate.

Tate, in 1864, had made a generalized statement about the relation of weight of drop to diameter of tube, the weight that could be raised by capillary action, and the temperature of the drop. Some of their conclusions are that:

(*a*) The drop-weight of any liquid is proportional to the diameter of the dropping-tube (these tubes are uniform in diameter, thus differing from the ordinary burettes).

(*b*) The weight of a drop, other things being the same, is proportional to the surface tension of the liquid.

(*c*) That it is possible to calculate the temperature at which the drop-weight would become zero, namely, the critical temperature of the liquid, for at that point the drop would disappear, there being no distinction between the gas and the liquid.

In the course of these experiments the surface tension of a number of organic liquids in aqueous solution was determined by drop-weight and found to range from 21 up to that of water. The tabulated results cover several pages in the *Journal*; I have copied a part and condensed into one table, which is given below.

It is to be noted that in all cases the very first addition causes a very considerable lowering of surface tension. The deerease in the surface tension of water caused by the addition of a very small amount of amyl alcohol is especially striking. Thus the presence in solution of even so small an amount as 0.25% changes the surface tension of water from 71.03 to 53.7, or nearly 25% at 30° C.

Morgan and Schramm studied many concentrations of a few salts. They seleeted the molten hydrated salts for this purpose; those salts which melt below 50° in their own water of crystallization being especially satisfactory for this purpose, for the reason that concentration in some of these cases could even be carried to super-saturation.

In the case of the salts which they studied it is plain that surface tension is increased by the salts introduced. Where calcium chloride was used, the surface tension was increased from 71.03 to 102.57, approximately 50%. Taking a few specific cases it is noted that to increase the surface tension 10% it would take

20% $CaCl_2$ at 30°
43% $Zn(NO_3)$ at 45°
29% Na_2CrO_4 at 30°
34% $Na_2S_2O_3$ at 40°

The diagram is appended. See Fig. 1.

The degree of accuracy of Valson's early generaliza-

Aqueous Solutions at 30°C.

Ethyl alcohol.		Methyl alcohol.		Amyl alcohol.		Acetic acid.		Formic Acid.	
%	Sur. ten.	%	Sur. ten.	%	Sur. ten.	%	Sur. ten.	%	Sur. ten.
0.000	71.030	0.000	71.030	0.000	71.030	0.000	71.030	0.000	71.030
0.979	65.600	1.011	68.120	0.250	53.712	1.000	67.756	1.000	69.816
2.143	60.847	2.500	64.845	0.500	46.157	2.475	63.995	2.500	68.024
4.994	53.137	4.097	60.294	0.750	41.247	5.001	59.435	5.000	65.706
10.385	44.668	9.994	53.661	1.000	37.631	10.010	53.500	10.000	62.061
17.979	37.311	10.000	48.817	1.500	32.504	14.980	49.451	15.000	59.197
25.000	32.941	25.000	41.809	2.000	28.667	20.090	46.455	25.000	55.190
50.000	26.521	50.000	31.843	2.498	25.726	49.960	37.109	50.000	48.112
75.000	23.850	75.000	26.173	....	.....	79.880	31.026	75.000	41.990
100.000	20.756	100.000	21.037	100.000	22.296	100.000	25.725	100.000	35.281

tion that equivalent salt solutions exhibit identical values of surface tension is shown by plotting the same results reduced to molecules of water to molecules of salt. But one must be careful not to carry generalizations too far because this does not hold with some salts. The diagram is appended. See Fig. 2.

The fact is that some salts elevate while others depress surface tension, but the former predominate. In addition to the salts just mentioned, the tartrates, carbonates, oxalates, citrates, lactates, and a part of the acetates raise surface tension; while the salicilates, the butyrates, part of the acetates, and all the acids lower surface tension. It is suggested that the liberation of free acid by hydrolysis in the case of salts of weak acids may cause their negative effect on water.

All acids lower surface tension, and in the case of the fatty acids experiments have shown that the lowering is proportional to the carbon content of the acid.

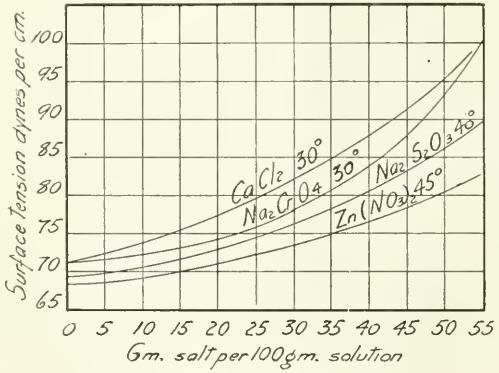


Fig. 1.

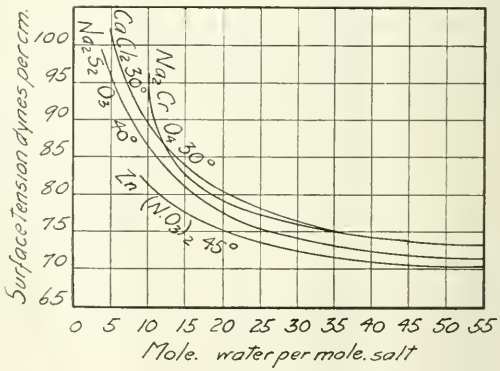


Fig. 2.

It is suggested in these researches that the surface tension of a solution of two salts one of which raises the surface tension and the other lowers it, is an additive property of the two solutions—provided no chemical reaction takes place between them, and the values of the two are not far removed from the value of water. If one of the solutes causes a much larger effect than the other, the value of the mixture lies closer to the one with the greater effect.

Regarding the variation of surface tension with temperature, it is made clear that surface tension increases with decrease in temperature.

In reviewing the subject of flotation in one of the mining journals about two years ago, a leading educator made the statement that heat increases surface tension. Now this is absolutely erroneous in case of pure water and it is not likely that it would maintain in any case. I do not mention this in a fault-finding spirit, but to show that in the science of flotation the metallurgical engineer faces problems in physics and chemistry that are absolutely new to him.

In the work in the chemical journals the surface tension of pure water is taken as 71.03 dynes per cm. at 30°, 69.33 at 40°, and 68.46 at 45°, while Hoover† uses 81 with apologies. Again Hoover makes a slip on page 77 where he says that surface tension of water has been determined to be a force of 81 dynes per square centimetre. Here he has confused surface tension in dynes per centimetre with surface energy in "ergs per sq. cm." Work (in ergs) is the act of producing a change in opposition to a force (in dynes) that resists this change. Now, gravity gives to a gram a velocity of 980 cm. per second. It is therefore equal to 980 dynes. Hence if one gram be lifted vertically one centimetre, the work done against gravity is 980 ergs. Books on physics‡ demonstrate that surface tension (dynes) per unit-width is numerically equal to surface energy (ergs) per unit-area. We should therefore speak of surface tension in dynes per centimetre, and surface energy in ergs, per square centimetre.

The above figures on surface tension and surface energy might be applied to the so-called surface tension method of flotation, such as the Wood machine, where the ore is fed dry onto the surface of water and at one place at least, in the West, where the wet oiled pulp is spread upon the surface of water in a spitzkasten.

While 0.0724 gm. (71.03÷981) per sq. cm. represents the weight that it requires to just break the surface membrane of pure water, there is another factor, and that is the size of the dimple formed. Take the case of galena. The buoyant factors are the membrane and the water displaced. Taking the specific gravity of galena at 7.5, the maximum volume of a dimple on one square centimetre would be 0.0096 cc. (0.0724÷7.5) or a displacement equal to 0.0096 gm. water. Adding the two quotients we find that 0.082 (0.0724+0.0096) gm. galena per sq. cm. would just break through. This is not mathematically correct, but a close approximation—sufficiently close, because we do not know the volume of the foreign water attached and the condition of the water.

Will H. Coghill.

El Paso, Texas, September 24.

†'Concentration of Ores by Flotation,' 2nd edition.

‡Carhart's 'University Physics,' Part I.

Hoisting Works in the Park City District, Utah—I

By L. O. HOWARD

The second of the large modern hoists to go into commission in the Park City district was that of the Daly West Mining Co. The surface plant of this company is situated around the main shaft in Empire canyon, two miles southwest of Park City, at an elevation of 8400 ft. The shaft is 2100 ft. deep. It has two hoisting-compartments, each 4 ft. 6 in. by 5 ft., and a small pump-and-ladder compartment. Second-class ore and waste are hoisted to the surface, and sent to the mill and dump respectively. First-class ore is hoisted or lowered to the 1200-ft. level and hauled 2½ miles through the Ontario adit to loading-bins at Park City. Concentrate is also lowered in cars on cages to the same level. During the summer months men and timbers are lowered from the surface. When the roads become impassable supplies are brought into the mine through the Ontario adit.

Late in December 1913 all the mining plant and mill of the Daly West was destroyed by fire. Shaft-house, hoist-house, boiler-room, and mill were either connected buildings, or in proximity to each other. As may be seen in the illustration of the surface plant, these structures are now separate, even the hoisting-engine being some distance from the shaft-house. The old hoist was a Bullock flat-rope and reel type, hoisting two triple-deck cages in balance. The head-frame was wood, 80 ft. high. The compressor was an Ingersoll-Sergeant two-stage, duplex, steam-driven type, compressing to 100 lb. per square inch, and displacing 2200 cu. ft. of free air per minute.

It is interesting to note that whereas the two other modern hoists in the district are of the flat-rope and reel type, and whereas the old Daly West plant was also of that type, the new hoist is equipped with double-drums and round rope.

This hoist differs from the others in the district. It is a Wellman-Seaver-Morgan double-drum type electrically driven through herring-bone gearing. The principal data concerning it are as follows:

Working load, about 15,000 pounds.
Diameter of drums, 60 inches.
Face of drums, 39 inches.
Capacity of drum, 2400 ft. of 1-in. round rope.
Rope, Roebling, 8-strand, 17-wire, 1-inch.
Diameter of drum-shaft, 8 inches.
Size of bearings, 8 by 14 inches.
Diameter of clutch, 60 inches.
Brakes, parallel-acting post-type brake-ring, 80. in. diameter.
Rope-speed, 1000 ft. per minute.
Capacity of skips, 4 tons.
Clutches and brakes are actuated by compressed air.

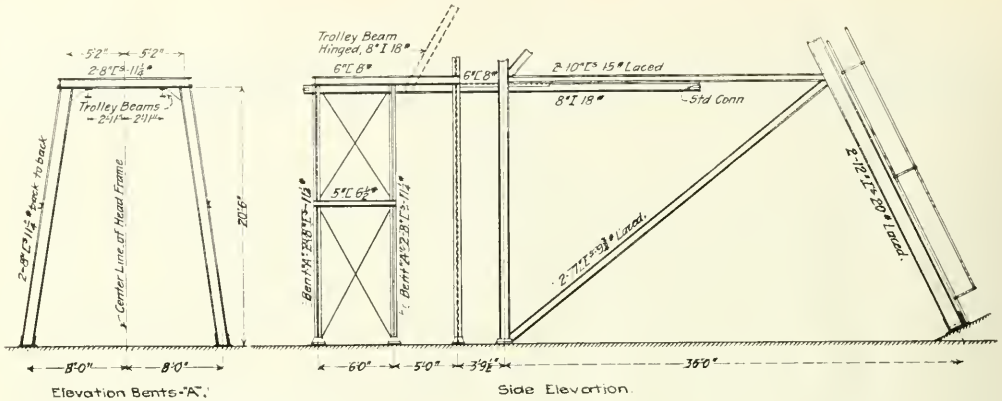
A steel head-frame has replaced the old wooden one. Its principal dimensions are:

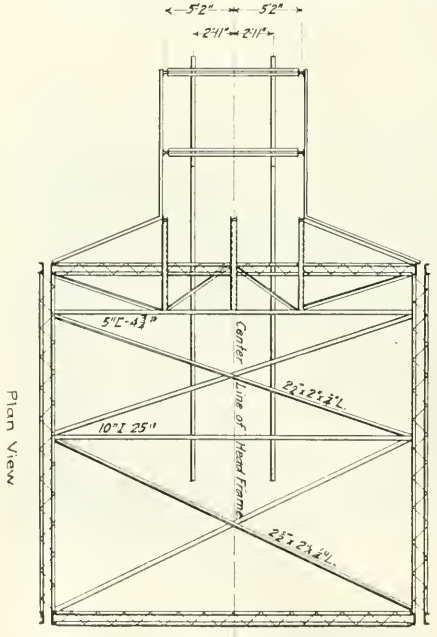
FIG. 1. VIEW OF HOIST-HOUSE AND HEAD-FRAME AT DALY WEST MINE, WITH RUINS OF THE OLD PLANT IN THE FOREGROUND.

Height from foundation to centre of sheave, 75 feet.
Width of tower, 32 feet.
Spread of tower, 36 feet.
Diameter of sheave, 7 feet.

The motor is a Westinghouse, type CI. It takes current at 2200 volts, 3-phase, 60 cycles, delivering 300 hp. at 500 r.p.m. Speed-control is by liquid rheostat. The following description of the construction and operation of the rheostat is taken from a leaflet issued by the manufacturer.

"The three secondary phases of the motor are each connected to a set of electrodes which are rigidly suspended in a tank; each set is insulated from the others. A liquid is pumped into this tank from a reservoir below by a small motor-driven pump and flows over a weir in the electrode tank back into the reservoir. The position of the weir determines the height of the level of the





PLAN AND ELEVATION OF THE DALY WEST HOIST-BUILDING.

Moving the lever in one direction closes the proper primary switches for starting the motor forward and raises the weir. Moving the lever in the opposite direction, reverses the motor and again raises the weir. Speed control is secured by varying the position of the weir by moving the lever; the primary switches do not open

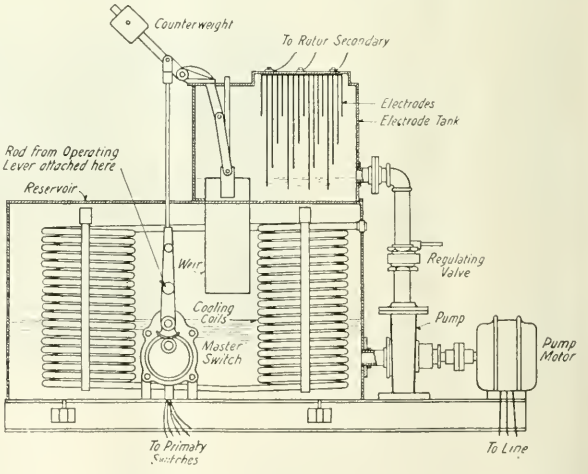


DIAGRAM OF CONSTRUCTION OF LIQUID RHEOSTAT.

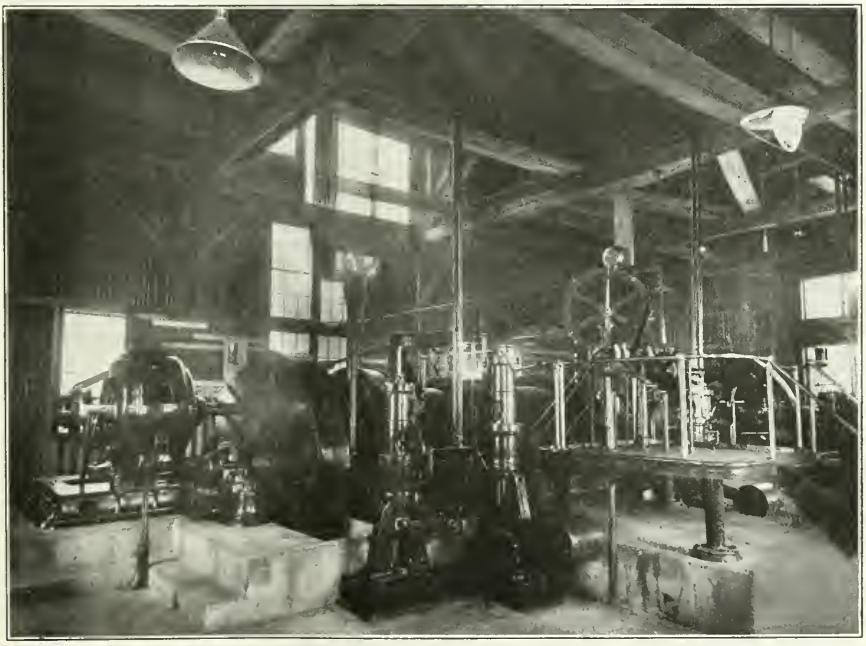
liquid in the electrode tank; the higher the level, the deeper the electrodes are immersed, and the lower the resistance. Hence, by changing the position of the weir the resistance in the motor secondary circuit is decreased or increased, depending upon whether the weir is raised or lowered, and a corresponding change in the speed of the motor is obtained. The primary circuit of the motor is opened and closed by means of electrically operated switches, which are controlled by a master switch mounted on the rheostat. The operating lever of the rheostat controls both the master switch and the weir. When the lever is in its central, or off, position, the primary switches are open and the weir at its lowest level, so that the secondary resistance is maximum. until the lever is placed in the off position. A valve in the intake pipe of the electrode tank regulates the rate at which the liquid is pumped in, so that no matter how quickly the operating lever is moved, the liquid can only rise at the rate for which the valve is adjusted, thus fixing the rate of acceleration. When the lever is returned to the off position, the weir drops and the liquid level promptly falls. The electrodes are rectangular iron plates. Each set consists of plates of different lengths so that the resistance decreases very rapidly as the liquid rises. The tanks are made of welded-iron plates. The reservoir contains coils through which cool water is circulated which prevents the rapid evaporation of the liquid. The weir is a cylinder with open ends. The

liquid pressure against it is equal on all sides so that the weir is easily raised and lowered."

Second-class ore is hoisted in skips dumping into bins in the head-frame. Men and timbers are lowered on two double-deck cages. The arrangements for changing from skip to cage or from cage to skip, familiar enough in the Michigan copper country, are rather unusual in Western practice, which seems to favor separate man-cages, operated by their own hoists. They are not, I believe, used elsewhere in Utah. Let us assume that ore is being hoisted and that it is desired to change to the cages: The cages are hung from trolleys traveling on the track-beams. Five men make the change, three working above and two at the shaft-collar. The operation is carried out as follows: The four hinged track-beams are thrown down over the shaft, filling the gap in the trolley-track. The guides are at the same time thrown back on hinges closed. The cage is then ready for use. The operation is next repeated with the other skip and cage.

The following cycle was timed by me under normal operating conditions involving no need of haste.

	Minutes.
Dropping trolley-track, placing platform, throwing out guides and hoisting skip	1
Attaching trolley-hook, slacking and detaching cable, swinging skip out of shaft	1
Pushing cage over shaft	½
Attaching cable, detaching trolley-hook	½
Lowering cage, throwing trolley-track back, removing platform, throwing in guides, and closing hood	1
Time changing one skip to cage	4
Bringing up second skip and carrying out similar operations	5¼
Total elapsed time	9¼



INTERIOR OF DALY WEST HOIST-ROOM.

Showing hoist-motor, gear-case, drums, operating platform, and brake mechanism.

and the skip-trolley run over the shaft. The skip is hoisted, platforms placed over the shaft-opening, the trolley-hook fixed, a rope attached to the cable, the clevis opened and the rope pulled out of the way. The skip on its trolley is then pushed back from the shaft upon its storage-track, and the cage-trolley is run out from the opposite side of the shaft into position in the head-frame. The hoisting-rope is attached and the trolley-hook disengaged and pushed back on its track. The cage is lowered slowly below the collar of the shaft, the portion of the trolley-track over the shaft is thrown back, the guides swung into place and locked, and the hood of the cage

The time consumed in making the change from skips to cages depends largely upon the hoist-engineer, all operations not involving the operation of the hoist being performed quickly.

Additional equipment in the hoist-house includes a Laidlaw-Dunn-Gordon compressor, a new type in this State. The cylinders are 29 by 16 by 24 in. The piston displacement is 2400 cu. ft. of free air per minute, compressing in two stages, to 35 and to 100 lb. respectively. The compressor is direct-connected to a Westinghouse synchronous motor, taking current at 2200 volts, 3-phase, 60 cycles and delivering 450 hp. at 150 r.p.m.

The Valuation of Metal Mines

By T. A. RICKARD

*The present value of a mine is based on an estimate of future profits. The profits are expressed in terms of money. The value of money differs with time and place. While money is unlikely to differ in value notably in the same place during the relatively short life of a mine, it is likely to be affected by the condition of locality. Money is worth less at New York than at Tonopah, for example, the prevailing rate of interest in the one case being 4 or 5% and in the other from 8 to 12% per annum. This difference tends to facilitate the transfer of a mine from an owner in the desert to a capitalist in the city. The latter is content with a smaller return on his "investment," as he is apt to call it. The difference in the point of view tends to promote business; it facilitates the sale of mining property.

In all business transactions the point of view is vital; hence the difference between the valuation of mines for purchase and the appraisal of them for taxation. Attempts have been made to put both kinds of estimation on the same basis. They have failed. The purchaser buys a mine to hold it and to exploit it until it is exhausted; when the purchase is completed, he cannot revise the transaction. If he buys with the idea of reselling, he must do so on the supposition that the next buyer will act intelligently; that is, as a sensible man, the purchaser cannot assume an escape from a blunder by the interposition of somebody more foolish than himself. Such assumptions, it is true, are not uncommon, but they proceed on lines of reasoning outside the limits of an economic investigation. Therefore, I repeat, the purchaser, whether an individual or a company, buys with a view to exploitation. The State, on the other hand, assesses the mining property annually, and is in a position to remedy any error in its estimate from year to year. The first appraisal is not irremediable; therefore it is not so momentous. Nevertheless the State authorities, recognizing the inherent difficulties of the problem and their incapacity to solve them, usually avoid them by simply taxing the output of the preceding year, that is, they prefer to deal with the statistics of actual production. They appear to recognize, or they may have merely surmised, that the ante-mortem diagnosis of a mine is necessarily aberrant. In truth, it is a tricky business. Having regard to the inherent difficulty of estimating future production, it is not surprising that the taxation of output has been adopted in many States as the most practicable method. It seems best for the purposes of annual taxation, even though it may fail to penalize those owners who choose to leave their properties idle in the hope of selling them at a higher price or of exploiting them when the market for their product is more favorable. This evasion can be checked, to some extent, by taxing the claim-area or acreage, whether productive or not, to such a degree as to render long idleness prohibitive.

The appraisal of mining properties for State taxation has had the good effect of drawing public attention to a subject heretofore deemed too recondite for general discussion. Mining engineers, among themselves and in the technical press, have touched upon the problems involved, but, on the whole, the solution of these problems has been deemed in the nature of a professional secret, to be left in the safe-keeping of the individual. The active members of the profession, or practitioners, it may be inferred, consider it impolitic to publish the particular basis on which any one of them might see fit to value a mine for his client. If an engineer were to state beforehand that he could not report favorably unless certain fixed conditions were fulfilled, he might cause sundry vendors to object to having their property subjected to a test so exacting as to render business impracticable, with the further unpleasant consequence of placing a black mark against the name of the mine. Moreover, the criteria to be used in valuing different mines by the same engineer will vary in accordance with the character of the mining and of the client. In some kinds of mining the uncertainties are vastly greater than in others; so also some clients are willing, and can afford, to take bigger risks than others. For reasons of this kind the scheme of valuation is rarely set down in black and white, not even for professional information, much less for public enlightenment.

Within recent years, however, the State of Michigan engaged a mining engineer of acknowledged repute, Mr. J. R. Finlay, to make an appraisal* of its mining properties for purposes of taxation. Other State Commissioners had tried to perform the same task under the guidance of politicians, labor-leaders, geologists, and various gentlemen distinguished by varying lack of fitness for the task. In this respect they were like the lay public, which is learning slowly and painfully that the only person likely to value a mine successfully is a mining engineer equipped with the requisite training and experience. It is fair to add, however, that the State of Wisconsin deputed the study of mine valuation and assessment in its zinc-producing territory to a member of its Geological Survey, namely, Mr. W. L. Uglow, whose report† gives the impression that he also, although

*A paper presented before the International Engineering Congress, San Francisco, 1915.

*'Appraisal of Mining Properties of Michigan,' by the State Board of Tax Commissioners, 1911.

†'A Study of Methods of Mine Valuation and Assessment,' Wisconsin Geological and Natural History Survey, 1914.

probably less versed in the management of mines, has envisaged the subject with convincing skill.

The official reports issued as a sequel to the investigations made by Messrs. Finlay and Uglow furnish an excellent text for a general discussion of the subject. Mr. Finlay states that his appraisal is "a calculation of the value of mines to the permanent owner for the production of minerals." The value of a mine for share-market purposes is ignored; so is its value for the purpose of re-sale. Neither aspect of the problem came within the province of his enquiry. The appraisal is based on three factors:

1. The average cost of production.
2. The average price obtained for the product.
3. The future life of the mine.

The first two are determined "by experience," that is, they can be ascertained by investigating the records of the mine and of the industry, with sagacious inferences therefrom. The third factor is "based partly on developed ore and partly upon an assumption of continuance of known orebodies beyond the present bottom levels of the mines."

From these three factors the future net profits, or dividends, are calculated. The present value of such dividends is then reduced by the annuity method to a sum upon which they will pay a given interest and at the same time provide an annual contribution into a sinking fund, which, re-invested, and added to prior installments similarly invested and re-invested, will redeem that sum within the period covered by the life of the mine. Mr. Finlay took 5% as the dividend interest and 4% as the rate of amortization. This may be accepted as adequate for the particular, and relatively safe, type of mining illustrated by the copper and iron deposits of Michigan, but in precious-metal mining, which is more hazardous, the rate of dividend should be at least 10%, with the possible exception of a few orebodies of extraordinary uniformity.

This method, of course, ignores unprofitable mines. It is also inapplicable to prospects. On the other hand, the mere discovery of mineral on land may give it an immediate and taxable value, to be determined on a different basis, as is shown in Mr. Finlay's report. In the productive copper mines he had a relatively simple problem. For instance, in the case of the Wolverine, the records showed that during the preceding five years the necessary data were as follows:

Yield of copper per ton of ore	26.7 lb.
Cost of producing copper per pound	7.65c.
Average price of copper per pound	15.60c.
Profit during the 5 years	$3,896,270
Estimated total future production of copper in pounds	80,000,000
Valuation of the mine	$3,700,000

The Wolverine orebody represents an enriched portion of the Kearsarge lode, which consists of a layer of amygdaloidal diabase impregnated with native copper. The lode has a fairly regular dip of 40° and has been traced on its strike for 5 miles through a series of most productive mines. Mr. Finlay assumed, or "calculated with certainty," that part of the Kearsarge lode will continue profitable to at least 6000 ft. in depth and that 60% of the lode-area within the known profitable length will be mined to that great depth, yielding an average of 16 lb. copper per ton. On this basis the lode would yield 70,000,000 tons of ore, in addition to the 20,000,000 already mined. And of the grand total he credits the Wolverine with 3,600,000 tons. He gets at this by taking the surface area covering the lode on its dip at 215 acres, and the thickness of ore at 12 ft.—for the stoping-width is remarkably regular. Estimating that the reserve of ore will last for 9 years, that the copper can be won at 8 cents per pound, leaving a profit (on a 14c. price) of 6 cents per pound, he obtains a total profit of $4,800,000 and a present value of $3,700,000.

In appraising the copper mines of Michigan, Mr. Finlay had no trouble in obtaining accurate data in regard to cost, for the books of the companies operating the mines were open to him. These companies are old and respectable; the technical management is first-class; any information required by an accredited investigator is given willingly and accurately. Mr. Finlay could have had no trouble in ascertaining the total cost per pound of copper. Then he had to make an estimate of the probable price of copper during the future life of the mines under appraisal. He decided that 14 cents would be fair, although personally inclined to believe that this was low. That was in August 1911. Since then the price of Lake copper has been as follows:

Year.	Average.
1911	12.63
1912	16.56
1913	15.70
1914	13.61

His estimate needs no apology. He was making an appraisal for annual taxation; presumably therefore the valuations of the various mines could be reviewed from year to year and corrected in accordance with the rise or fall in the price of copper. If he had been valuing the mines for a purchaser, he would, by taking 14 cents as an average price, have been no more conservative than we should reasonably expect an engineer to be under such circumstances. In short, he is justified in the result.

As regards the life of the mines, Mr. Finlay could make no personal examination in the time at his disposal: he had to examine the records, with maps and sections, assisted by the willing information of the managers. On this he could rely to a degree not usual in the examination of mines in private practice. The copper mines of Michigan are well developed, the character of the orebodies is well understood, the relative persistence of the ore has been ascertained. Indeed, the non-persistence beyond a known horizon helps the appraiser, who is not called upon, as in some regions, to give serious thought to dreams of unlimited continuity in depth. The length of ore likely to be extracted is, in most cases, determined either by the boundaries of adjoining properties or by exploratory work, for the intelligent mine-operator endeavors to ascertain these fundamental facts as soon as

possible, in order to plan intelligently and to equip providently. Therefore I conclude that Mr. Finlay's estimates of 'life' were so correct as to afford a safe basis for the appraisal required by the Tax Commission.

Turning to the similar effort at scientific valuation in Wisconsin, two years later, it will be found that Mr. W. L. Uglow was instructed by law to assess mineral land at the "full cash value" it would bring "at private sale." This was understood to mean "a sum of money which engineers and business men would be willing to pay for a property if they should have full knowledge of all the facts of past production and future prospects at their command." The lack of "full knowledge" in regard to future production is, of course, the crux of the whole matter; indeed, it is the one awkward factor, and for that reason it is usually pushed into an obscure background.

Conditions in Wisconsin are relatively simple. The owners of the land are mostly farmers, who lease the ore-bearing areas to mining companies. The latter test the ground by churn-drilling and then sink their shafts, preparatory to extracting the ore, which lies at a shallow depth, the maximum being about 250 feet below the surface. A royalty of about 10% on the gross output is paid the owner as his rent or share of the earnings. He pays the real-property tax, as well as an income-tax on his rent. The orebodies have their greatest dimension horizontally; about 10% of the crude ore is left as pillars; the ore consists of blende, galena, and pyrite disseminated in limestone; it is subjected to concentration, the concentrate being sold to the smelting companies. The properties are small, for the shallowness of the deposits does not compel concerted effort or big capital expenditure.

In order to get at a reasonable basis for valuing the zinc mines of Wisconsin, Mr. Uglow takes a "hypothetical zinc mine," built upon the figures obtained from eight properties; these figures in turn he reduces to weighted averages over a period of four years. This four-year life is assumed on the basis of local experience. Of course, a whole lot of other assumptions have to be made, such as the price of spelter, which is put down as 5.7, 5.4, 5.0, and 5.5 cents per pound for the four years respectively, although it is not clear why the guess should not be made uniform. Apart from the fact that the price of zinc is beyond the vaticination of any appraiser of mines, it is noteworthy that in the last stage of his valuation Mr. Uglow deducts 15% "on account of the absence of data for checking the assumed figures for grades of ore." If 15%, why not 51%?

Having constructed this hypothetical mine, Mr. Uglow applies it to ground "well drilled" and ground "poorly drilled at the outset." The present value in the one case is $168,117 and in the other $125,180 at the beginning of the first year.

Next he applies various systems of valuation to this hypothetical mine and arrives at the conclusion that the most suitable method for the zinc mines of Wisconsin is that of equated income. To ascertain the value of a mine, therefore, he multiplies the annual operating profit by 2.43, this factor having been determined by mathematical analyses on the assumption of equal annual profits and an average life of 4 years. He concludes that, as compared with the *ad valorem* method, this scheme has the advantage of being based on the estimated average life of all the mines, not a particular one, in the district; it is calculated on the actual profit of the preceding year, not upon an estimate of future profit; moreover, it is well adapted to taxation because it assesses a mine in accordance with its ability to pay, rather than its sale-value.[2]

Again we face the fact that the valuation of a mine for purchase and its assessment for taxation constitute two different problems. The tax-gatherer's valuation is made annually, and can be revised annually, therefore it is convenient to base it upon the actual profit—not production—of the previous year. The future does not concern the tax-gatherer; he takes short views of life; it is his duty annually to collect a contribution to the revenue of the State in equitable proportion.

We shall leave him to his troubles, which are relatively small, for it is our purpose to discuss the valuation of mines for sale or purchase, which is a far more difficult problem.

In order to value a mine, that is, to determine the price at which it is a reasonable purchase, it is necessary to estimate its future profits. That is done in successive steps, ascertaining:

1. The average yield per ton of ore.
2. The average cost per ton of ore.
   (The difference between 1 and 2 is the 'profit.')
3. The tonnage available now.
4. The tonnage likely to be available in future years.

Each step demands skill and experience. The yield is determined by a careful sampling of the ore exposed in the workings, by comparison with past records, and by an estimation of the probable extraction in the mill or smelter. The metal contents as determined by assay do not represent the yield; to ascertain that it is necessary to know the percentage of extraction by the metallurgical method most suitable. Mines are bought sometimes on the expectation of applying increased skill to the extraction of the metals from the ore. The expectation may prove too flattering.

The average cost can be ascertained from past records, with corrections based upon any anticipated change of conditions. The anticipations may prove fallacious. The records may be deceptive. 'Cost' is interpreted variously. Among British-owned mines, particularly in Rhodesia and West Africa, it is customary to give a figure for 'cost' that omits many inevitable items of expense, such as head-office expenses, taxes, insurance, depreciation, improvements, recruiting for labor, even development and prospecting. In some cases the omissions represent discrepancies of 30 to 40% from the actual cost, giving phantom profits highly useful for share-market purposes. The big mines of the Rand

[2] 'Method of Mine Valuation and Assessment,' by W. L. Uglow, page 68.

issue monthly figures of profits that are illusory because in the cost the Transvaal profit-tax is omitted, together with London expenses, income-tax, debenture interest, and additional expenditure on new equipment. The result is that the profits periodically announced are 30% more than the dividends. I have always argued[3] that the profit to the shareholders, who are the owners of a mine as conducted on the joint-stock principle, is represented by the dividends that actually get into their pockets or are lodged to their bank-accounts. To many persons some of the items, such as interest and taxes, seem beside the mark. The borrowing of money on debentures, however, usually represents a miscalculation in the original estimate of initial expenditure for development and equipment. As for income-tax, it may be said that it is only a matter of book-keeping, since the collection at the source obviates later payment by the shareholder. But the income-tax on a mine is a true (and most inequitable) item of cost, for in most cases it is a tax not on income but on the return of capital. Until a mine has redeemed its purchase price, its dividends are not income. A mine is a wasting asset.

Many blunders in valuation are made by engineers owing to lack of knowledge concerning the 'overhead' expenses. Any sagacious appraiser of a mine that is to be placed on the London market, and managed from there, should add from 10 to 20%, according to tonnage of production, to his operating or local cost, if he expects to make a forecast that will stand the test of future accomplishment. Indeed, the best school for the appraiser is last year's almanac; let him read the old reports and valuations of mines now approaching exhaustion. He will see how errors were made and how estimates were falsified. For example, the small additions to equipment made from year to year may seem a minor item. No allowance usually is made for re-building or replacing the existing reduction works, yet no mill or smelter remains intact for many years, if the owners are progressive. Fires and other accidents will happen. Decay and destruction, wear and tear, are inseparable from machinery and equipment. For example, the cost of new equipment at the Bunker Hill & Sullivan mine, in Idaho, averaged 80 cents per ton during 22 years, on a total operating cost of $2.66 per ton.[4] Again, when I examined the Camp Bird mine in 1900 I found that Thomas F. Walsh, the owner, had extracted $2,535,000 worth of ore at a cost of $6.50 per ton. I estimated the ore assured at $6,000,000 and anticipated that the cost could be reduced to $5.25, in consequence of an improved equipment and larger tonnage of production. The mine more than fulfilled the expectations of productivity and profit, but the average cost was $10 per ton. The administration and general expenses of a London company proved more costly than I had anticipated, in comparison with the thrifty management of an individual owner. The reading of old reports shows that a post-mortem will give data more reliable than those obtainable from a diagnosis made while the patient is alive; unfortunately, old reports disappear, to the comfort of the profession, and exhausted mines cease to be interesting, except to the historian; therefore this source of guidance is not readily available to the student of the subject under discussion.

Turning to the question of tonnage. The ore exposed can be measured and an estimate of that which is partly exposed can be made with reasonable accuracy by an experienced engineer, that is, by one wise to the vagaries of various types of ore deposit. When, however, the next step is taken, namely, the estimation of ore likely to be rendered available in future years, as the result of intelligent development and exploration, the engineer faces a crucial problem and one that may render all his previous ratiocinations utterly futile. The test of science is prediction; the inability of the mining engineer to predict the continuity of an orebody suggests that the appraisal of mines is not a science, but an approximation based upon empiricism.

Attempts have been made to express the probabilities of ore-persistence by formulae. Some engineers allow for future prospects by adding a fixed proportion—from 20 to 35%, for example—to the ore already proved. Such short cuts are illogical. They constitute a mere surmise. Mr. H. C. Hoover has suggested that "the minimum extension of an orebody or ore-shoot in depth below any horizon would be a distance represented by a radius equal to one-half its length."[5] This may apply to his special experience in Western Australia, but it is dangerous doctrine, for, as he himself adds: "This is not proposed as a formula giving the total amount of extension in depth, but as a sort of yardstick which has experience behind it." Another writer, with less experience and therefore greater positiveness, has offered sundry elaborate formulae[6] for the purpose of expressing the probabilities of ore-extension in depth. These, apart from their academic interest, are interesting as indicating how many uncertain factors are involved in the calculation. They are useful as suggesting a line of reasoning, based upon the length and thickness of the ore-shoot, the number of levels already proved, and the patchiness of the lode within the ore-shoot. Indeed the methods of an actuary may be illuminating to an engineer, but the latter must realize that human life has been studied much longer than the distribution of ore underground, and that the eccentricities of human nature are better understood than the vagaries of ore deposition. Calculations based on a large number of guesses can only yield a guess. The doctrine of probabilities has been stultified in mining too often to allow of its being stated as a scientific thesis.

Having ascertained the tonnage of ore in the mine and the probable profit per ton, the engineer can say that the ore assured will yield so much money, while the ore likely to be uncovered will enable so much more

[3] *The Mining Magazine*. Editorials, April, June, and July, 1912.

[4] 'The Valuation of Mines,' by T. A. Rickard. M. & S. P., May 24, 1913.

[5] 'Principles of Mining,' by Herbert C. Hoover, 1909, page 31.

[6] 'The Finance of a Mine,' by M. H. Burnham. *The Mining Magazine*, June 1911, page 445.

money to be taken out of the mine in future years. How much then is the property worth?

While the estimation of ore in most mines is hazardous, especially in the case of rich precious-metal veins or lodes, it is a pleasant fact that in certain types of deposits the size and continuity of the orebodies are such as to minimize the variation of metal-contents to the point of relative uniformity of production over long periods. This is true, or has been true for many years consecutively, of the native-copper lodes of Michigan, the gold-banket of the Witwatersrand, the gold-bearing schist of the Homestake, the copper-pyrite lenses of Huelva, and the extensive chalcocite impregnations of Nevada, Utah, and Arizona. However, even in these cases, it must be confessed that, for purposes of appraisal, the knowledge now available has come at a late date; it has come in the wake of experience, not as the result of preliminary investigation. Moreover, it is not applicable to other mines in other regions, save at great risk. Most young mines—and it is young mines we must appraise, as it is young people that we must insure—cannot be judged on the basis of experience on the Rand or in Michigan. That is why engineers with local experience in particular districts so often fail in diagnosing mines in other districts.

We return to the question: what is a mine worth, given an estimate of future profits? We have seen Mr. Finlay's formula, based on 5% for interest and 4% for amortization. I have said that his return of 5% might do in the case of the copper and iron mines of Michigan, but it was too low for most mining enterprises. Mr. Hoover says that "the mining business is one where 7% above provision for capital return is an absolute minimum demanded by the risks inherent in mines, even where the profit in sight gives warranty of the return of capital."[7] With this, of course, I agree. Indeed, in most precious-metal mines 10% is not too much. On the other hand, no figure can be stated as generally applicable. It depends upon the factor of risk, which varies in each case, not only as regards the continuity of the ore, but the capacity and honesty of the management. This feature of the problem has been well elucidated by Mr. Burnham,[8] who asks, and answers, the question as to how much a mine ought to pay over the standard rate of interest on gilt-edged stock. Besides the addition to cover "the yearly contribution for capital redemption," he insists that provision be made for "the risk of loss of either capital or interest." Thus by the time the engineer has made his estimate of the value of ore assured and the profit therefrom, he finds his figures blown into the air by this explosion from under his very feet. These final considerations regarding the rate of return on the purchase price of the mine afford divergencies so big that all the little refinements of measuring, sampling, and assaying are rendered pitifully inconsequent. If we take the standard rate of interest on national bonds as 3% and if we add to this another 4% for capital redemption, we are brought face to face with the decision as to what further percentage must be made to provide for the risk inherent in mining and the final risk involved in a particular mine. Suppose we agree on the third item of our enquiry and call it 3%, even then we have the fourth item to ascertain— and it is by far the most momentous in the whole of our enquiry. It may range from 0 to 100%.

Let me illustrate. Many years ago I examined a small silver mine in Boulder county, Colorado. The vein was narrow but rich. The ore-bearing ground was sampled thoroughly. The result was to show that $150,000 worth of ore could be extracted at a cost of $40,000, working through an existing adit, so that $110,000 could be earned. The owners were willing to sell for that sum, half cash and half in six months. The winzes below the bottom level or adit showed that the vein was poor and broken by faults. The prospects in depth seemed to me slim. I considered it a poor purchase, because the risk of the known ore yielding less than the amount estimated outweighed the probability of finding more ore in virgin ground. Even 100% per annum—that is, the return of the purchase price in one year, as was feasible in this case—was not good enough. The later story of the mine justified this decision.

In a recognized guide to these matters, namely, the "Report Book for Mining Engineers," by A. G. Charleton, an example of mine valuation is given. In this hypothetical case the property contains 704,000 tons of ore averaging $12 in gold per ton, making $8,448,000. Allowing for a recovery of $10 and a cost of $7.50 per ton, the profit comes to $2,464,000. The conditions specified are (1) that the above profit is to be won over a period of 11 years, (2) the plant and equipment are to cost $183,700, and to this is to be added compound interest for two years at 5% during the time of development precedent to profitable production, (3) the capital is to be redeemed at 2½%, and (4) the purchaser is to be allowed 20% on his money. Therefore the present value is $290,000. As if this were not drastic enough, Mr. Charleton shows that on a 40% return the present value would be $4. This *reductio ad absurdum* shows where these methods of valuation land. After taking great pains to sample the ore and equal trouble to ascertain the profitable metallurgical recovery, after having inquired thoroughly into the question of cost and made several solemn guesses at the persistence of the ore—having solved these preliminary problems, the engineer is to choose between 5, 10, 20, or even 40% as the rate of return required to justify the 'investment.'

The elaboration of any calculation should be proportioned to the possible accuracy of the factors involved. Otherwise it fares no better than the New Jersey farmer's method of weighing sheep. The animal is attached to one end of a fence-rail while a bag of stones is attached to the other end. First the exact centre of the unloaded rail is ascertained, then the sheep and the bag of stones are fastened at an exactly equal distance from the centre, or fulcrum, and a perfect balance is obtained. When all this has been done with painstaking care, the bag is emptied on a clear bit of ground and the weight

[7] *Op. cit.*, page 43.

[8] *The Mining Magazine*, May 1911, pp. 361-363.

of the stones is guessed. Why not guess at the weight of the sheep in the first instance?

Obviously, therefore, mines are not to be appraised on the basis of an investment. Whether iron or coal mines are so different from those yielding the precious metals, or copper, lead, and zinc, as to warrant a different treatment, I leave it for others to state. My own experience has been chiefly in gold and silver mining. In the case of gold, one factor, namely, the market price of the metal, is eliminated. Just now the price of the base metals is subject to abnormal fluctuations, but even in peaceful times this element of uncertainty is an essential part of the business. Some of the bigger copper mines have reserves so large and operations so systematic that the perturbing factors are apt to be forgotten. Promoters and brokers speak of such steady producers as "manufacturing propositions," meaning that they are on an enduring basis. This, of course, is balderdash. A mine is a wasting asset. It has no goodwill; that exists in the management and is transferable to another mine, but it does not ensure the life of a particular property. The resources of a mine are not renewed; at some stage in its history they are underestimated and conjectural, but that does not mean that they are increased; they are merely uncovered. The art of mining cannot be applied on scientific principles until two basic ideas are fully comprehended:

(1) A mine is a wasting asset.

(2) Mining is a speculative business.

To treat a mine as an investment, and to appraise it on that basis, is to ignore the cumulative facts of today and of other days. Mining is a speculation that can be made wise or foolish according as a man recognizes the inherent risk and takes his chances accordingly. As a speculation it is highly profitable when conducted intelligently. The ascertainable factors are sufficiently numerous to place a premium on trained observation and the inferences therefrom are sufficiently valuable to give an advantage to men of intelligent experience. The unknown and unknowable elements in the problem will remain so numerous and so important as to involve a risk so large, and the chance of a winning so big as to stimulate the adventurous spirit of man.

Unusual Mine Accident in Tennessee. An old diamond-drill hole was used for breaking rock by first placing an old ladder-rung in the hole to act as a backing and then loading the powder and tamping on top of it. After spitting the fuse the miner retired through an S-shaped passage to a place about 125 ft. away and thought he was perfectly safe. It happened, however, that he stopped exactly opposite the distant end of the very diamond drill-hole in which the charge had been set. When the shot went off the backing blew out underneath the dynamite and a considerable part of the force of the shot was transmitted through the hole as through a long gun-barrel. Small fragments of rock were discharged against his back, so that he was badly injured.

The Britannia Copper Mine

*British Columbia claims the largest copper mine in the British Empire, the Britannia mine on Howe Sound 25 miles north of Vancouver. The plant when finished will treat 4000 tons of ore per day. The ore contains 3% copper and a little silver; it is estimated to be worth $8 to $10 per ton. Development by adits, shafts, and levels indicates several million tons of ore at Britannia Mountain, 3.8 miles from the beach and outcropping at an altitude of 3500 ft. An aerial tramway 13,000 ft. long and of 1000 tons daily capacity is carrying the ore to the mill; incidentally, the force of gravity of the descending buckets is utilized to operate an air-compressor at the mine, and the tramway has also been used to transport machinery and supplies. This tramway will continue in operation after the electric railway system is completed. A 30° inclined railway a mile long now under construction (at a cost of $140,000 per mile) will deliver ore to the mill. In addition there will be an electric railway 3½ miles long of 3% grade.

Two years ago construction of a new mill was begun near the present mill on the slope of Britannia Mountain where benches have been terraced out of rock to allow a gravity system. Concentration will be by Hancock jigs and tables, the slime going to a Minerals Separation plant. The tube-mills are 7 ft. diam. by 12 ft. long. A 1000-ft. tunnel under the mill will transport concentrates over the electric railway to the docks for shipment to the smelter at Tacoma.

Records show a production from the mine of $8,582,000 since 1905. The 'Copper Handbook' says: "The Britannia proved a hard problem to handle for years, but made money in 1911 and 1912." G. B. Schley of New York promoted the enterprise, after others had failed. The varied history of the mine since its accidental discovery in 1888 and its second discovery in 1898 has shown the necessity for large-scale operation. Fully $6,000,000 has been expended on the purchase of properties, equipment, timber, and water-rights; of this $2,000,000 was derived from profit through ore shipments. An additional $1,000,000 has just been placed at the disposal of the management. It is hoped that the costs will be reduced to 50 cents per ton for mining, 35 cents for milling, and 5 cents for transportation. Optimistic predictions are made that copper can be produced for 8 cents per pound. At present the British government is taking the output for manufacturing munitions. At least 1000 men will be employed. A hydro-electric plant of 5000 hp. is being erected, but auxiliary steam-power of an additional 5000 hp. will also be required.

It is hoped that this modern development of low-grade ore by exponents of big business will give encouragement for the financing of other prospects of British Columbia's undoubted mineral wealth. Credit is due to the men who have persevered in the effort that has made the Britannia mine a reality.

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*Abstract of article by E. A. Haggen, in the *Mining, Engineering and Electrical Record* for August, 1915.

Mining in Colorado

By GEORGE J. BANCROFT

Recent developments in Colorado are as hard to report as the progress of a line-bucking football team. There are few sensational 'end runs' or 'forward passes.' The progress is steady and irresistible, but very difficult to tell about. Even the busy local reporter misses the news. For instance, I met a man from a certain camp in Colorado today and he told me of a mine that has gradually increased its production of a certain rare metal until now it is shipping 100 tons daily of high-grade ore. I have diligently searched the files of the local paper and find not a single record of this fact. I mention this incident because it is so typical of present progress in Colorado. In the good old days when the promoter with the big diamond stud in his shirt-front went 'back East' and brought home the 'tub full of kale' and opened up the mine with the aid of the 'ne'er-do-well' son of the plutocratic president and the artful advice of the high-salaried machinery salesman, there were some easy gleanings for the lords of publicity, but when Tom, the 'leaser,' and Bill, the grocer, and Frank, the saloonkeeper, 'chip in' to open up an old mine, you can never tell, from the outward aspect of things, whether they are crushing the dump to macadamize a road or straining the elastic limit of the bullion vault of the local bank.

So it is with mining progress in Colorado this year. The mining supply-houses never did a bigger business. More powder, fuse, and caps have been bought than ever before in the history of the State, but the notable and interesting difference between today and former times is this: Five years ago a few celebrated mines would account for 75% of the mining supplies shipped out of Denver while 25% went to 'leasers' and unknown buyers. Nowadays the percentage is almost reversed, namely, 75% goes to unknown and unheralded buyers who order goods shipped C.O.D. and 25% goes to well-known mines. That the multitudinous unknowns are placing their shots in the right places is shown by the constantly increasing shipments of ore, but the names and addresses of our 1915 mining magnates would be as hard to congregate as a flock of mountain goats.

A discovery that marks the trend of recent events in Cripple Creek is that on Tenderfoot hill. The local press announces the recent large shipments as coming from a new discovery, and, in a measure, this is true, because the present operators have only recently discovered that reduced working costs in the Cripple Creek district permit of the mining of such low-grade ore as exists on Tenderfoot hill. Large bodies of low-grade ore, however, were developed on Tenderfoot hill as far back as 1899, to my personal knowledge, and it is a far more important 'discovery' to find that working costs have gradually been hammered down to a point where these ores are marketable than to find some individual orebody that had hitherto been overlooked.

Ten to fifteen years ago a number of long-tunnel projects were launched in Colorado. Among these may be mentioned the Yak at Leadville, the Smuggler-Union adit at Telluride, the Newhouse Tunnel at Idaho Springs, the Pro Patria at Rico, and the Roosevelt at Cripple Creek. At the time of launching these enterprises there was a good deal of doubt as to their paying qualities and, taken as a class, long tunnels have proved to be very low-

[Compiled by Charles W. Henderson, U. S. Geological Survey.]

County.	Short tons.	Gold.		Silver.	Copper.	Lead.	Zinc.	Total value.
		Placer.	Deep.					
				Fine ounces.	*Pounds.*	*Pounds.*	*Pounds.*	
Boulder	14,591		$98,710	312,217	24,316	523,821		$295,029
Chaffee	61,698	$626	331,604	272,242	319,496	3,690,359	2,173,177	780,029
Clear Creek	101,366		495,275	345,387	367,790	2,435,692	1,067,314	884,615
Costilla		177		2				178
Custer	870		3,365	15,975	3,481	9,692	4,470	13,268
Dolores	6,905		7,973	86,526	350,278	492,023	366,549	140,292
Douglas		140						140
Eagle	49,377		47,194	127,080	28,105	1,177,385	7,522,098	550,752
El Paso	25				2,644			352
Fremont	706		1,476	1,066	191,917	308		27,602
Garfield	73		2,403	80	128			2,464
Gilpin	52,839		573,533	145,237	726,579	499,718	12,980	770,655
Grand	10		3	1,747		1,563		1,030
Gunnison	6,018	4,384	8,649	59,036	11,188	317,974	525,000	86,344
Hinsdale	118		170	5,987	17,098	5,723		5,978
Lake	547,463		1,571,451	3,810,830	2,382,910	26,784,615	78,763,334	9,057,297
La Plata	5,083		126,498	60,244	26,038	11,410		163,721
Mineral	27,952		19,304	615,734	32,586	1,401,795		418,809
Moffat		4,436		11				4,442
Montrose	66	435	11	517	32,414			5,043
Ouray	105,560		1,211,993	594,289	854,038	2,119,564	44,608	1,739,160
Park	1,758	23,930	43,555	20,215	8,023	168,154	57,934	89,244
Pitkin	118,000		423	372,886	67,737	23,233,230	145,431	1,129,151
Rio Grande	8		474	16				483
Routt		261		5				264
Saguache	1,488		16,513	18,203	35,783	534,872	8,941	52,704
San Juan	117,988		508,477	493,917	825,180	5,199,000	971,177	1,143,653
San Miguel	495,942		2,114,916	1,280,461	324,105	4,039,769		3,023,668
Summit	22,199	608,567	60,043	67,009	7,339	1,565,231	5,111,941	1,028,395
Teller	939,423		11,996,116	89,056				12,045,364
Total, 1914	2,677,526	642,956	19,240,149	8,796,065	6,639,173	74,211,898	96,774,954	33,460,126
Total, 1913	2,734,866	408,540	17,738,376	9,325,255	7,227,826	87,897,773	119,346,429	35,450,585
Increase (+) or decrease (−)	−57,340	+234,416	+1,501,773	−529,190	−588,653	−13,685,875	−22,571,475	−1,990,459

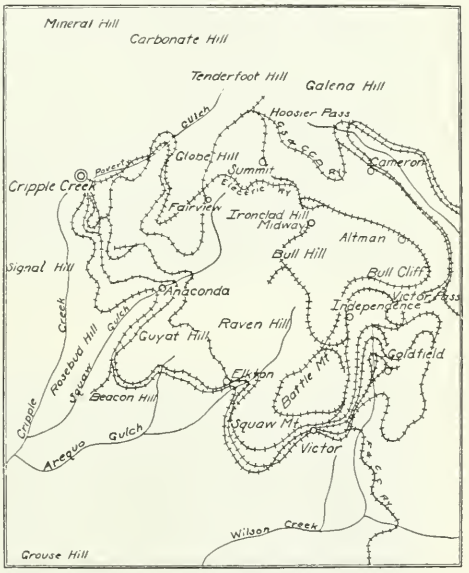
ORE AND METAL PRODUCTION OF COLORADO IN 1914.

dividend earners for the stockholders. It is a fact, nevertheless, that nearly all the great 'tunnel,' or adit, projects in this State have turned out to be great successes so far as stimulating ore production is concerned. Prospecting in wet ground is so discouraging that very little of it is attempted, but prospecting in drained ground is relatively easy, and so it happens that territory drained by an adit receives much more attention than equally good ground that is not so drained. The acquisition of the Alladin group by the Yak Mining, Milling & Tunnel Co. is a case in point. This ground lies near the end of the Yak Tunnel. It is very wet territory and probably would have remained undeveloped for years had it not been drained by the adit. The price named in the lease and bond, namely $600,000, indicates that the Yak people consider the property one of considerable value.

There are many remarkable things connected with the progress of mining in Cripple Creek. One is the geologic form of the deeper ore-shoots and the other is the low working-cost that has been attained in the mining and milling of relatively small ore-shoots of refractory ore. The strange thing about the deeper orebodies is the fact that many of them have no apparent relationship with orebodies nearer the surface in the same locality. It is true that all the deep ore that has thus far been discovered lies under territory that was rich near the surface, but it must be remembered that there are hardly any deep workings except in localities that were very profitable near the surface for the simple reason that no one has had the capital or nerve to prospect any other territory at depth.

In the Vindicator mine the two best levels were at 800 ft. and 1600 ft., but the big stope on the 800-ft. level was nearly 1000 ft. north from the big stope on the 1600-ft. level. Vertically over the big and rich bodies on the 1600 the ground was not particularly good. Vertically below the big rich stopes on the 800-ft. level the ground was not particularly good. On a line connecting the two rich spots the ground was not particularly good. In other words, both of these extremely rich places were isolated. The rich ore on the 1600 was found, for the most part, in veins that are not identified above the 1100-ft. level. In fact, this ore was found in the third horizon or zone of enrichment that occurs in this part of the mine and each zone has its own veins and characteristics, which are distinct from those of the other two. This peculiar condition seems to prevail all over the district. There seems to be no reliable rule for deep prospecting at all. It seems likely, of course, that the deep ore lies approximately underneath territory that was enriched near the surface, but even for this hypothesis there is little evidence. The unusual mineralization of Cripple Creek irresistably inspires speculation as to the geologic causes of it. We know from data collected all over the world that gold mines are closely related to the surface. Very few gold mines extend below 500 ft. from the surface without showing some change. So the first speculation that suggests itself is that Cripple Creek has had several periods of mineralization and that the surface at the time of the first period was buried several hundred feet deep by succeeding lava-flows before the second period began, and so on. The trouble with this speculation is that the granite rim is on a horizon only a few hundred feet below the surface in many places. It does not seem likely that the surface of the ground was ever very far below the granite rim; in other words, it does not seem likely that Cripple Creek was ever a great hole in the ground.

It is devoutly to be wished that we knew enough about the genesis of the Cripple Creek orebodies to direct developments intelligently at great depth. Here is a great chance for an ambitious geologist. It may not be generally known that ore is being mined and milled in Cripple Creek at a cost under $3 per ton. Furthermore



THE CRIPPLE CREEK DISTRICT.

an extraction of about 80% is being effected by cyanide without roasting the ore. For years we have been reading of low working-costs in the exploitation of large deposits of free-milling gold ore, such as the Alaska Treadwell or the Homestake, but I think that very few mining men, ten years ago, would have prophesied that telluride ore, occurring in relatively small orebodies, could be worked for $2.60 per ton, and yet I know of one Cripple Creek mine that is doing this, and I have reason to believe that several of them are actually making a little money on $3 ore. To accomplish such good work it is necessary to use the most scientific methods and to have the very best of men. Cripple Creek is lucky in having some of the brightest men in the industry at the head of her mines and mills and in having a splendid set of workmen.

Preliminary magnetic examination of iron-ore deposits in Minnesota has an important bearing on the situation of subsequent drill-holes.

Igneous Intrusions

By T. A. RICKARD

On the opposite page we reproduce two illustrations obtained by the courtesy of the Director of the U. S. Geological Survey. They appear also in Professional Paper No. 66, as illustrations of the geology of Goldfield, Nevada. We reproduce them because they have a timely interest, in view of recent mining developments in that famous district. The upper picture shows the lower portion of a flow of rhyolite where it penetrates the shale, as exposed in a prospect-hole on the west side of Columbia mountain. The arrows are close to, or point at, the line of contact. The lower photograph shows the same shale (*A*) intruded by a tongue of alaskite (*B*). The alaskite is supposed by F. L. Ransome to have been in a "highly viscous" state at the time of the intrusion, so that "it solidified in contact with the shale before the general movement of the magma had ceased." Here 'magma' is used with reference to the fact that alaskite is a rock representing one of the last silicious phases of differentiation in the consolidation of a granite mass. This was the idea of J. E. Spurr, who likened the Nevada alaskite to the Russian beresite, another quartz-feldspar derivative.

When a granitoid magma consolidates, the silicious remainder (that is, the excess silica left after the formation of such silicates as were competent at the prevailing temperature and pressure and degree of dilution) forms a rock or series of rocks, of which alaskite is a familiar example; and there are also thrown out from the consolidating magma certain silicious solutions that result in the formation of dikes and stringers of quartz in the fractures through which they make their way. Occasionally these solutions contain gold, so that in depositing the quartz they build what is in effect a gold-bearing quartz vein.

Auriferous quartz dikes are sometimes of commercial importance, although commonly they vary erratically from zero to high value, as shown by assays of samples taken at different points on the same deposit. This generally renders them unprofitable. The gold in these dikes has a tendency to develop isolated widely-separated masses or aggregations of particles of the precious metal in the quartz, or to concentrate with iron minerals in vugs, or geodes, preferably occurring on the walls or along comby partings occupying a more or less central position longitudinally through the dike. In general, it may be said, quartz dikes are untrustworthy as a source of gold unless subsequent movement has produced conditions favoring the formation of true veins. That is, as distinguished from dikes. The latter are formed by the filling of a fracture with foreign material, which, when injected, does not react with the enclosing rock save as to the changes due to contact metamorphism. The 'true' vein, however, represents the product of reactions involving a predominance of chemical interchange between the invading solutions and the material of the invaded rock. Since any dike may be a line of later weakness, and since quartz dikes are frequently of great longitudinal extent and but feebly adherent to their bounding walls, they are apt to determine the course of subsequent faults, through which mineralizing solutions may circulate. Owing to the peculiar character of these ultimate silicious magmatic differentiates, in which the silica is supposed to exist free in a colloidal state, they seem incapable of exerting the chemical effects recognized as interchange or 'metasomasis.' In other words, they do not produce a new set of vein-minerals by a process of chemical substitution, and only in so far as uncombined bases are presented to them before consolidation of the silica, as quartz, do they lead to the formation of epigenetic silicates. Silica-bearing solutions capable of substitution carry the silica combined, usually with alkaline bases that are soluble in water at normal temperatures. These solutions must be sharply distinguished from the colloidal[1] silicious residuum of magmatic differentiation. The latter would exist as a fluid of relatively high density, in which a moderately high temperature is a pre-requisite to solvency. Such is not necessary in the case of alkaline vein-forming solutions of the sort that produce the great majority of the profitable gold mines of the world.

The connection between ore deposition and magmatic waters seems to be chiefly one of re-sorbed[2] roof-masses[3] carrying waters that were probably of meteoric origin. The distinction between strictly meteoric and strictly juvenile waters is a difficult one to draw. Much remains for the geologist of the future to demonstrate in this connection. It would appear necessary to show in any case of vein formation from ascending thermal solutions that these do not in reality represent the penetration of a massif[4] from above progressively with the cooling of the

[1]Colloid is a form of matter existing as a homogeneous suspension in a liquid, or as a continuous jelly, called a 'gel,' having pores filled with the liquid. They behave similarly to true solutes, unlike them they no not alter the freezing point nor the vapor tension of the solvent.

[2]'Re-sorbed' is a term indicating the fusion, into an intrusive mass, of fragments from the rock through which the magma, laccolith, dike, or other form of invading material, is being injected.

[3]'Roof-masses' are bodies of rock overlying an intrusive magma, laccolith, or other invading igneous body, and which frequently becomes detached, collapsing into the molten or plastic intrusive.

[4]'Massif,' in the older geology, has been applied to fault-blocks, that is, to a block displaced as a unit without undergoing any internal alteration because of such displacement. The term was restricted to blocks of great size, constituting important mountain masses, and usually of one species of rock with its normal differentiates. Since a magma represents a great petrographic unit considered as a portion of the deeper-seated crust of the earth under conditions resulting in fusion,

RHYOLITE INTRUDING SHALE.

ALASKITE INTRUDING SHALE.

magma after its consolidation, and also that the mineral load in solution is not merely the product of alteration of the rock under conditions of elevated temperature and pressure.

Differentiation of magmas does result in concentrations of certain metals, some preferring the attenuated silicious end and others the extreme basic pole of segregation.[5] This, however, is largely a matter of the normal chemical relations of the metals toward the bases and acids of the magma, rather than one of solvency in solutions. J. H. L. Vogt was one of the first exponents of the idea of metallic concentrations in magmas by differentiation, to which Mr. Spurr early gave his support. It is doubtful, however, whether concentrations formed in this manner are often of economic importance. There has been ordinarily a later concentration by circulating waters, or by diffusion through the capillary waters, to finish the work begun within the still plastic magma.

It is difficult for the miner to understand how relatively thin tongues or sheets of igneous rock can remain fluid long enough to permit of penetration for a great distance into presumably cold rock. In the first place, the intrusion took place usually at a depth where the temperature was higher than at the surface. Next, the outside of any intrusive mass cools so as to form a protection against the radiation of heat, the solidified exterior coat acting as an insulating cover. Finally, there is the fact of the feeble conductivity of most rocks of the earth's outer envelope. The slag in the pot of the smelter remains molten because the shell, or 'skull,' formed by cooling contact with the iron, prevents the escape of heat. At Bendigo, in Australia, dikes less than a foot thick can be seen making their way through three or four thousand feet of sandstone and slate, and the portion of their course that may be observed is only a fraction of that which they must have traversed. Even with an explanation it seems astonishing that a mere thread of lava (at Bendigo it is a basic phase of dolerite) should work its way amid fractures and faults through much older rocks for such a distance. There the sandstone and slate are of Lower Silurian age, while the dolerite is Miocene, so that a vast interval of time separates the periods of their origin. It must be observed that the lavas capable of intruding great distances in the form of thin sheets or 'sills' are of the more basic kinds, which require a large degree of superheat to cause fusion, but which remain pasty for longer periods than acid rocks at similar temperatures.

it becomes a petrographic unit, and is generally labeled a 'massif.' Thus the term becomes one suitable to distinguish between the petrographic unit after its consolidation and the same unit while still having motive power for intrusion, which latter condition involves mobility, whether due to actual fluidity or to mere plasticity. The magma is the mobile igneous rock; the massif is the consolidated igneous rock.

[5]'Segregation' is the tendency developed in rocks during their mobile period, and during their successive stages of consolidation, to separate, or split, into fractions, each fraction possessing a certain characteristic homogeneous chemical or mineralogical composition, different from other fractions produced within the same magma.

Alloys in Engineering Construction

*Among the more important materials of construction are alloys usually differing in properties from the metals from which they are made. The most extensively employed alloys are those of which copper is the base. In these copper is mixed with zinc to make brass or with tin to make bronze. Both brass and bronze have been used from remote antiquity. Brasses cover a range of from 55% copper and 45% zinc to pure copper. The alloys containing from 63 to 70% copper are known as 'high brass.' These especially combine strength, uniformity, toughness, and ability to withstand manipulation. They are not capable of being worked hot, but are used in sheets and strips, seamless tubes and wire. The value of these 'high brasses' is due to their resistance to corrosion, and ability to withstand forming operations.

Muntz metal contains between 55 and 63% of copper with 45 to 37% zinc; it is strong, relatively cheap, and can be worked hot. Seamless tubes of Muntz metal are made by the Mannesmann process, by which solid cylindrical billets are pierced by hot rolling and subsequently finished by cold drawing. Lead, up to 3 or 4% is added to Muntz metal, forming a mixture that can be easily machined at very high cutting-speeds and can, at the same time, be readily extruded. For purposes where great strength is essential, Muntz metal is alloyed with as much as 1½% tin, or tin and iron. The former mixture is the rolled bronze of the U. S. Navy, while the latter constitutes manganese-bronze.

Alloys containing about 80% of copper are called 'low brass'; with 90% of copper, 'commercial bronze'; while those with 95% of copper are termed 'gilding.' The bronzes are next in importance to the brasses; they consist of copper alloyed with tin. In the production of satisfactory bronzes it is necessary to use a flux; phosphorus is usually employed, forming phosphor-bronze. This material has an extensive application where hardness, strength, and reliability are required. Red brass is a term applied to alloys of copper, zinc, lead, and tin; a very wide range of strength, toughness, color, cost, and machining qualities may be obtained. The copper ranges from 76 to 87%, lead from 3 to 6%, tin from 2 to 7%, and zinc from 3 to 16%.

A standard mixture for bearings when heavy pressures are to be met is 80% copper, 10% tin, and 10% lead; phosphorus is used as the flux. Aluminum-bronze contains a maximum of 10% aluminum; the strength increases with the increase of aluminum, but the ductility decreases with the highest strength of 85,000 lb. per square inch. Nickel and copper readily alloy and yield products having useful qualities, but are expensive. Monel metal is a natural alloy in that the copper and nickel are mixed in the ore from which it is made; it contains 68% nickel, 2% iron, 30% copper, and has a tensile strength of 65,000 lb. per square inch.

*Abstract of a paper by W. Reuben Webster, read at the International Engineering Congress, San Francisco, September 22, 1915.

What Constitutes a Mining College?

By P. B. McDONALD

The number of mining colleges and schools of mines that are springing up over night suggests naturally that not all of them are necessary. Obviously the quantity as well as the quality of mining engineers that can be absorbed advantageously into the mining business has limits. Equally obvious is the fact that incapable colleges, with a backing of bumptious superficiality, will detract both in students and standing from institutions of worth. The point then is: What is a real mining college and what is merely an imitation? What is the prime requisite? A building? Advertising? An appropriation? Location? Equipment? Professors? How is the prospective student to choose a college? In which institution will he really learn mining and metallurgy and absorb the spirit to succeed in the profession; and in which will he find mining merely a farce, where dilletanti "take geology with the girls" or otherwise fail to appreciate the point of view that makes for success in a particularly arduous career.

The essentials for a real mining college can be divided under two heads: the first class includes such practical matters as location and equipment; the second pertains to the less material but equally important consideration of the men behind the institution, graduates, professors, and instructors, trustees or Board of Control, and the students themselves.

A school of mines must have either a location in a broad-gauged mining district where operating mines can be visited and inspected, or it must have a large and costly equipment to show, in miniature, what mines, mills, and smelters are in reality. A college having neither adjacent mines nor adequate equipment is in no position to inculcate a knowledge and understanding of mining in young men, many of whom never saw a mine and most of whom have extremely hazy ideas as to what underground operations look like. The variegated and elaborate equipment for a proper teaching of mining and metallurgical operations can scarcely be accumulated in a hurry. Time and experience are required to develop the combination best suited to fulfill the requirements. There is a great deal to be said for a mining college that teaches nothing but mining. Where all efforts and endeavors are bent toward producing a single effect, the result is especially helpful to a subject so difficult to teach as mining.

But by far the most important side of a school of mines is the men who make it. It is well, in judging a college, to look at the men it has produced. There is a certain indefinable quality or stamp placed on the men that have graduated from particular institutions. The idea behind this factor is indicated by the recent remark of a president of a well-known mining college. It was as follows: "The minute a professor begins to think more of his remuneration than of ideals of teaching, he is no longer fit for his position. It makes no difference how much he knows, he has lost his usefulness." A college with ideals contributed by the men who have been associated with it is a real college. A building, no matter how ornate, an appropriation no matter how magnificent, and a professor of mining without ideals serve to furnish only an imitation of a thing that does not stand imitating at all well. A man without principles is not worth a damn; neither is a mining college. Both can make a splurge for awhile, and can muster up a make-believe that may look like the real thing. But both are equally useless in the end, and are likely to do more harm than good.

A popular university, a year or two ago, decided to install a course in mining. For the head of the new department, the institution offered to an unusually capable assistant-professor of mining, in a mining college of high standard, a substantially better salary than he was then receiving. To the astonishment of the university officials, the assistant-professor in the small college declined with thanks the opportunity to become head of the new department of mining in the large university. This is not an isolated instance; other cases of the same kind are on record. To the average outsider, a man who refuses to better his position and salary—particularly his salary—seems so unusual in these modern days as to be more or less of an oddity, and to betray poor judgment. But it is to be remembered that seeming to be doing something is not always more productive than actually doing something, especially when a long period of time is considered.

A student picking out a mining college to attend might do well to keep in mind that the one which makes the most noise is not necessarily the best for him. Nor need the one that is nearest be the surest to put him farthest in the long run. It is not where he is at 25 years of age that counts; it is where he will be later on. The influence of a good training will extend over the whole life of its graduates.

GOLD in sea-water was the basis of a swindling company, at North Lubec, in Maine, that collapsed in 1898. Gold exists in the ocean at the rate of about two cents per ton of water; in San Francisco bay the quantity is equal to four cents per ton, and in Salt Lake rather more than in the ocean. The most attractive method of extracting this gold would seem to be the treatment of the bittern or residual water from the manufacture of common salt; this is a solution concentrated in the proportion of 100:1 so that one ton of bittern ought to contain about $2 in gold. Hence, this brine contains more gold than the ore of the Wasp No. 2 or the Alaska Treadwell. Who will be the first to treat it commercially? Another Rev. Jernegan?

GOLD OUTPUT of the Transvaal for the first half of 1915 totaled 4,408,048 oz. At the current rate of production the year will yield about $10,000,000 more than in 1914.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Condensed sea-water is the only available supply for the power-plant of the Chile Copper Co. at Tocopilla. Oil-fired water-tube boilers are used.

In acetylene lamps for mines, one ounce of good carbide makes about 500 cu. in. of acetylene gas. An ordinary miners' carbide lamp uses nearly half an ounce of carbide per hour, making up to 0.144 cu. ft. of gas.

Decomposition of sulphide ore, forming acid, which came into contact with limestone of the Albion mine, Little Cottonwood district, Utah, is considered to be the cause of accumulation of gas that resulted in an accident lately.

Zinc oxide is always present in zinc-dust, varying from under 5 to over 20%. Dust containing over 15% oxide should not be used for precipitation in cyanide-plants. Zinc-dust does not oxidize much in dry air, but in a moist atmosphere oxidation is rapid to a certain point, when the rate decreases.

Scheelite, a tungstate of lime, is used for hardening steel. It is generally mined alone, but the number of instances where it occurs with gold is increasing. Among these are a deposit in the South Island of New Zealand, the Wasp No. 2 mine of South Dakota, the Suan Concession in Korea, the Atolia district in Kern county, California, and in the Union Hill mine at Grass Valley.

Advantage of the replacer over the thickener-dilution method at the West End mill, Tonopah, is considered to be in the smaller installation required, and the amount of barren solution required compared with the large tonnage of barren and partly barren solution of the dilution method. The main drawback to the replacer system has been a lack of faith in its principles and mechanical features.

Coins are usually considered as made of gold, silver, nickel, copper, or bronze. Platinum was used formerly in Russia. An unusual coin is found in the Yap or Caroline islands, where limestone blocks are used as a measure of value. The small stones are in vogue for private trade, while for payment of war-indemnity stones up to two tons in weight are employed. One recently acquired by a Japanese museum is valued at $100.

Gold dredging, in its modern form, originated in New Zealand. In 1902 the maximum number of 202 dredges was reached. Since then the number declined until in 1913 there were but 74 dredges operating. The greatest weekly output by a New Zealand dredge was attained by the *Lady Ranfurly* during the six days ending November 4, 1904, when 1273 oz. of gold was obtained. This dredge, up to the end of 1913, had produced $1,077,000, of which $630,000 had been distributed in dividends.

In the Appleton, Wisconsin, filtration-plant, the water is treated with alum solution, passed through coagulating basins for settlement, and then pumped to the city mains after 2 lb. (10c. per lb.) of liquid chlorine per 10,000,000 gal. is added. Filtration reduces the bacteria present in the original river water by 98.5%, the chlorine destroying most of the remainder. The total cost is $6.18 per 1,000,000 gallons. This offers a good suggestion to managers of mines, desirous of promoting the health of the community.

The chief market for cobalt oxide, the ceramic works of Europe, has been closed by the War. Consequently the shipments from the silver refineries of Cobalt, Ontario, have been greatly reduced, falling off in value 85%, from $379,152 to $56,812. Some consignments have been made to Great Britain and the United States. Metallic cobalt is now being produced both at Deloro and Thorold, Ontario, and is finding a use in the manufacture of high-grade and high-speed tools, also for the plating of metallic objects, replacing nickel for this purpose.

Silver in the Tonopah-Belmont mine occurs as silver sulphide, antimonial silver sulphide, arsenical silver sulphide, with iodine as a base, and native silver; probably deposited somewhat in the following order:

Silver sulphide	argentite
Antimonial silver sulphide	stephanite, pyrargyrite
Arsenical silver sulphide	polybasite, proustite

Silver iodide, chloride, bromide, and native silver. The ore contains 72% silica.

Acetylene lamps have been used exclusively in the Granby Consolidated company's copper mines at Phoenix, British Columbia, since the end of 1913. The carbide light is considered much superior to candles, particularly where large openings result in a good draft. The candle bill was 0.0053c. per ton of ore; the carbide cost 0.0039c., over two periods of 14 months each. Miners pay for their own lamps, the company supplies carbide and repairs, but the men take care of them. In the Le Roi No. 2 mine, at Rossland, the carbide light is said to affect the men's eyes.

Over-thrusts or fold-faults are especially connected with anticlines and occur as the end result of an intense plication. There is often no sharp boundary between the disturbed zone along which the thrust has taken place and the undisturbed beds; but generally there is a gradual passage from crushed material to normal deposition. The extent to which beds are displaced by over-thrusts varies from a few inches to hundreds of yards or even miles. Swiss geologists, especially Maurice Lugeon, consider that over-thrust folds, where the displacement amounts to a hundred miles, or more, account for much of the structure of the High Alps.

Eastern Metal Market

New York, October 1.

With the exception of tin, all the metals have a reasonably strong tone, and prices have been advanced, or at least maintained. Copper, under the influence of some large buying on both foreign and domestic account, has advanced, and electrolytic is quoted at 18 to 18.25c., New York. It is hoped that the clearing up of the foreign loan will bring England into the market. Zinc rose to 14.50c., New York, under a good demand for spot and nearby deliveries, but is now showing a somewhat easier tendency. Lead is very strong, with independents asking a shade over the quotation of the A. S. & R. Co., while second-hands are unwilling to sell unless at an attractive figure. They are more disposed to buy. Tin has been dull, and at the end of the month was most adversely affected by the fact that there was in stock and landing no less than 4546 tons. Antimony has slightly greater strength because of an impending Government purchase; but consumers in general are showing little interest. Aluminum continues scarce for delivery inside of the next few months, and some lines are severely affected by the high prices.

In the steel trade the great question continues to be one of deliveries. Foreign consumers and makers of steel rounds for shells continue to take enormous quantities of unfinished steel. The general quotation for plates, shapes, and bars is now 1.40c., Pittsburg, with some of the mills asking 1.45c. The railroads are buying more cars, locomotives, and rails, though of the last named it would be impossible to get large deliveries in the near future. Sellers of foundry pig-iron are holding firmly to their advanced prices for 1916 delivery, although melters are slow in getting on the order books.

COPPER

In the past few days there has been some heavy buying of copper, especially for export to France, although a few domestic consumers having large war contracts have also been purchasers. Several million pounds has been taken. Now that the details of the $500,000,000 Anglo-French war loan are completed, it is hoped that England will soon come into the market for a large quantity. The New York quotation for electrolytic went to 18c. cash on September 27, following the taking of some large quantities. Wall Street appears to be playing a larger part than usual in the matter of prices, many of the trade declaring, more or less facetiously, that copper prices are today made in that district. Of course it is to be considered that financial conditions do have a large effect on business generally. Some of the producers are now asking 18.25c., 30 days, delivered, and a few quote 18.50c., but business has been done at 18c., in fact, that is the price said to have been paid in recent large sales. Lake is quoted at practically the same price as electrolytic, 18c. cash. One phase of the market which is a bull influence, is that second-hands have practically withdrawn offerings, and this they seldom do unless they anticipate higher prices. It remains a fact that purely domestic, industrial consumption, such as is so largely depended on in times of peace, has not improved to any great extent. The exports this month make another poor showing, totaling 14,327 tons.

ZINC

From 13.75c., New York, quoted on September 22, the spelter market has advanced to 14.50c. for spot and nearby metal. A good business was done up to the first of this week which carried prices upward. Since then a slightly easier feeling has been manifest. Futures continue to excite but slight interest. The London market advanced £2 per ton on September 30, but the price there was still over ¼c. below New York parity. Quotations for delivery to the end of the year range down to 13.25c. From Baltimore comes news of the arrival there of the first cargo (4500 tons) of Australian zinc concentrates consigned to the United States Steel Corporation for its new smelter at Donora, Pennsylvania. Exports last month aggregate the excellent total of 4914 tons.

Sheet zinc is unchanged at 16c. base, f.o.b. mill, carload lots, 8% discount for cash.

LEAD

The lead market has been steadily gathering strength, and day after day it has been expected that the A. S. & R. Co. would announce an advance in its price which for some time has stood at 4.50c., New York. Outsiders have not only been unwilling to sell at 4.50., but second-hands have been buying lead at 50c. per ton advance over the Trust price. A fair business is reported. London has been getting stronger also, the quotation there advancing on September 30 2s.6d. to £23 17s.6d. Exports from September 1 to 30 totaled 2628 tons.

TIN

Just prior to September 30 the market was showing a better tendency, but the appearance of the statistics showing that deliveries for the month had been only 4300 tons, whereas there was in stock and landing at the end of the month 4546 tons, caused quotations to soften. On September 28 the market rose to 33.25c., but two days later it was down to 32.50c., and on Friday the quotation was 32.25c. For many days the market has been exceedingly dull, with no interest shown in any positions, and spot and futures quoted alike. Arrivals of tin at and for Pacific ports in September aggregated 347 tons, making the total for nine months 1230 tons, approximately the same as in the same period of 1914. The following classification of tin imports since January 1, was compiled by the secretary of the New York Metal Exchange, C. Mayer.

	1915.	1914.
Straits	*31,466	28,429
Australian	10	45
Banka and Billiton	2,936	246
English	2,215	2,610
Chinese	1,130	895
Sundries	178	679
Total tons	37,935	32,904

*11 tons exported deducted.

ANTIMONY

A temporary factor lending a better tone to the antimony market is a request for bids on 50 tons for delivery to the Frankford arsenal, Philadelphia. The quotations still range, however, from 28.25 to 28.50c. for Chinese and Japanese grades. Domestic antimony is offered at ½c. less than the minimum for imported.

ALUMINUM

The quest for aluminum for prompt delivery continues, and the scarcity is such that 48 to 50c. is asked. As matters now stand only an increase in the production can bring about easier prices. Probably this would have eventuated before this had not the War tied up foreign capital interested in aluminum projects in this country. The high prices have created a severe situation for the makers of die castings, who use considerable quantities of aluminum in the alloys which they cast into parts for the automobile makers. The die-casting trade has had a struggle for existence. In the future more attention will be paid to the reclamation of aluminum scrap on which subject the U. S. Bureau of Mines will soon issue a paper describing commercially successful processes. Melters of scrap have met with many difficulties, owing to trouble in securing a proper coalition of the metal when chips coated with oxide, oil, and dirt are melted.

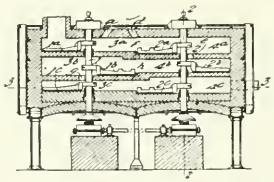
Recent Patents

Process of Precipitating Copper from Solution. George D. Van Arsdale, East Orange, New Jersey. Filed December 26, 1907. Serial No. 408,127.

1. The herein described process of precipitating copper from a solution of a copper salt which consists in precipitating copper from the solution by adding sulphur dioxide thereto, and in neutralizing free acid formed by the re-action, during the time of the precipitation.

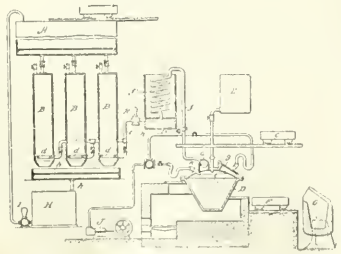
2. The herein described process of precipitating copper from a solution of copper sulphate which consists in precipitating copper from the solution by adding sulphur dioxide thereto, and in neutralizing free acid formed by the re-action, during the time of the precipitation.

Ore Roasting or Drying Furnace. Harry Mackenzie Ridge, London, England. Filed October 6, 1913. Serial No. 793,666.



1. In multiple hearth furnaces for roasting or drying crushed ores or the like, having two or more vertical shafts carrying arms which rabble the ore and cause it to traverse successive hearths in opposite directions, means whereby superimposed portions of said successive hearths and the relative rabble shaft or shafts and rabble arms can be put out of action without interfering with the working of the other part.

Recovery of Cuprous Sulphide from Ores and the Like. Raymond F. Bacon, Pittsburg, Pennsylvania, assignor to Metals Research Company, New York, N. Y., a corporation of Maine. Filed January 24, 1914. Serial No. 814,147.



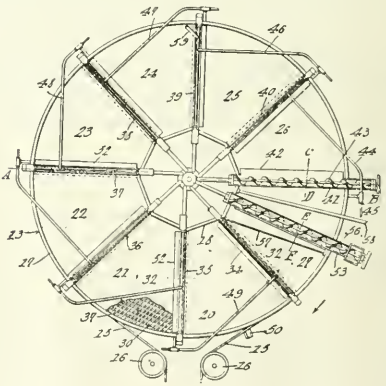
1. The method of recovering cuprous sulphide from ores and the like, which consists in leaching out the copper therefrom by a suitable solvent, precipitating the copper from the solution as cupric sulphide by means of hydrogen sulphide, thus regenerating the solvent, reducing the cupric sulphide to cuprous sulphide by means of a hydrocarbon with the simultaneous production of hydrogen sulphide, and using the hydrogen sulphide thus produced for the precipitation of cupric sulphide from a further quantity of the copper solution; substantially as described.

Ore Concentration. John W. Littleford, San Francisco, California, assignor to Minerals Separation, Limited, London, England. Filed December 15, 1913. Serial No. 806,770.

1. The hereindescribed process for separating the valuable metalliferous constituents from the gangue slimes contained in ore pulp which consists in coagulating the said gangue slimes by adding to the ore pulp an emulsion of a soap and pine oil, and separating the coagulated gangue from the metalliferous constituents of the pulp.

2. The hereindescribed process for separating the valuable metalliferous constituents from the gangue slimes contained in ore pulp which consists in adding to the ore pulp an emulsion of soap and pine oil in approximately the proportions by weight of 32 parts pine oil, 9 parts anhydrous soap, and 59 parts water, and thereafter separating the coagulated gangue from the metalliferous constituents of the ore pulp.

Ore-Leaching Apparatus. Murray C. Godbe, Salt Lake City, Utah. Filed December 3, 1914. Serial No. 875,354.

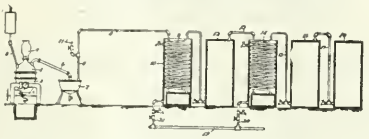


1. Apparatus of the class described, including a horizontal table mounted for continuous rotation, said table including separate non-communicating compartments and a continuous filtering medium extending over the compartments, means for feeding a layer of material onto the filtering medium, means for subjecting the moving layer of material successively to the action of a countercurrent of leaching solution, said solution gradually diminishing in strength toward the point where said material is fed onto the table, and means adjacent the feeding means for removing material from the filtering medium subsequent to the action thereon by the strongest portion of the solution.

Method of Treating Metalliferous Materials and Recovering Solvents Used. Harry D. Rankin, Crafton, Pennsylvania, assignor, by mesne assignments, to Rankin Process Company, Phoenix, Arizona, a corporation of Arizona. Filed July 17, 1909. Serial No. 508,108.

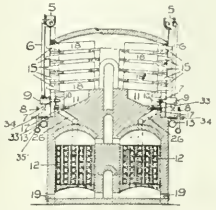
1. The method of treating metalliferous material containing acid forming substances for the purpose of recovering the values contained therein, which consists in treating the same in a closed vessel with nitric acid while subjected to pressure and maintaining it at a temperature below 125°C.

2. The herein described method of treating ores and metalliferous bodies, which consists in treating finely divided metalliferous substances with carbonic acid gas at suitable tempera-



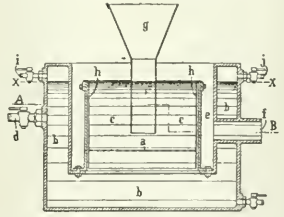
ture and pressure, to form soluble bicarbonates, and removing the same from the residue, and then treating the residue with nitric acid, and recovering the NO evolved to form HNO_3.

Method of Smelting Sulphide Ores. Henry L. Doherty, New York, N. Y. Filed April 20, 1911, serial No. 622,360. Renewed January 19, 1915, serial No. 3154.



1. The process of treating zinc sulphide which comprises pulverizing the sulphide, burning the pulverized sulphide in aerial suspension to heat a spelter furnace for the reduction of oxidized zinc, separating the zinc oxide formed by the said combustion from the gaseous products of the combustion, mixing the said oxide with the proper proportion of carbonaceous material and smelting the said mixture by the heat generated by the combustion of fresh sulphide.

Apparatus for Separating Minerals and Like Materials. Friederich Arthur Maximilian Schiechel, Frankfort-on-the-Main, Germany. Filed August 22, 1910. Serial No. 578,440.

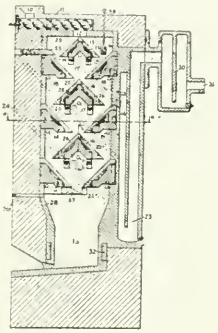


1. In apparatus for separating minerals and like materials, a separating compartment having a bottom formed by a perforated or foraminous bed, a surrounding annular compartment communicating with said separating compartment, from underneath the perforated or foraminous bed, a water supply pipe furnishing said communicating compartment with an uninterrupted water stream continuously rising in the separating compartment, a closed air chamber above the water line of the communicating compartment, means for applying intermittent air pressure within said air chamber, a discharge compartment into which discharge the water and tailings overflowing the upper edges of the separating compartment, and means for feeding material to the separating compartment.

Electric Reduction of Zinc Ores. Woolsey McA. Johnson, Hartford, Connecticut, assignor to the Continuous Zinc Furnace Company, Hartford, Connecticut, a corporation of Connecticut. Filed October 17, 1912. Serial No. 726,254.

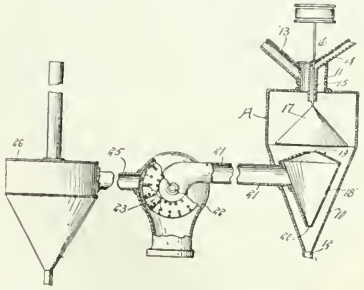
1. In the electric reduction of complex zinc ores, including in their analysis sulphur, lead, and calcium or barium, preliminary calcining said ores to the substantial elimination of sulphates with the exception of sulphate of lead and such sulphates of calcium, and barium as are present, and then reducing the residual sulphates to sulphides; substantially as described.

Electrical Furnace. William H. Hampton, New York, N. Y., assignor to the Conley Electric Furnace Company, Incorporated, Wilmington, Delaware, a corporation of Delaware. Filed February 28, 1913. Serial No. 751,258.



1. An electrical furnace for the reduction of zinc or the like provided interiorly with a staggered arrangement of guide members extending in proximity to each other and partly inclosing a plurality of connecting cavities with sloping surfaces over which the material flows from one to another in a zigzag downward course, non-arcing resistance means in the interior of said guide member for internally heating the surfaces thereof so as to heat the material as it flows thereover, and means for leading off at different levels from said cavities the material vaporized from the charge.

Ore-Separator. Charles H. Brown and Charles C. Parker, Eureka, Utah. Filed April 20, 1915. Serial No. 22,634.



A device of the class described comprising a casing having an air inlet and a material inlet in its upper end and a material outlet in its lower end, a rotatable spreader within the casing beneath the material inlet, a second casing disposed within the first casing beneath the spreader and having openings in its upper and lower ends respectively, said lower end being in proximity to the lower end portion of the outer casing, and a suction device connected with the interior of the second casing.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

CRIPPLE CREEK, COLORADO

Gold Output.—Drainage-Tunnel.—Electric Signals.—Water Pipes Over Bad Ground.—Strong and Queen Development.—New Plant to Treat Surface Material.—Dump Treatment.—Modoc Mine.—Placer Operations.—Jerry Johnson Mill.

The output of the district for September, as reported by the mills and smelters, is as follows:

Plants.	Tons.	Average value.	Gross value.
Golden Cycle, Colorado Springs	43,000	$18.00	$774,000
Portland, Colorado Springs	10,300	21.00	216,300
Portland, Battle Mountain, Cripple Creek	19,150	2.88	55,150
Portland, Independence, Cripple Creek	9,900	2.00	19,800
Gaylord-Dante	1,500	3.50	5,250
Caley	1,117	3.46	3,864
Kavanaugh-Jo Dandy	1,000	2.00	2,000
Smelters, Denver and Pueblo	3,875	55.00	213,125
Total	89,842	$14.35	$1,289,489

In the Roosevelt drainage-tunnel a new water-course has been cut, resulting in an increased flow of 1500 gal.; the total quantity is now over 12,000 gal. per minute. During August the advance in the breast was made at an average rate of 7½ ft. per day.

The Empire State shaft of the Isabella property is temporarily closed. A new system of electric-light signals will be installed. It will be a good one, being selected by the mining inspector. A few days ago a confusion of hoisting signals resulted in the accidental death of two men who were caught in the shaft timbers; hence the new apparatus.

The city of Victor and the Portland Gold Mining Co. have entered into an agreement whereby all trouble relative to the danger of breakage in the water-pipe has been eliminated. The main, which supplies Victor with water, crosses old filled and open stopes, and gradually settling ground between the Independence and Portland mines. It has long been a source of danger and menace to the Portland, Strong, and Independence mines. By the terms of the new agreement the pipe is to be taken up and re-laid where it will be safe. The Portland company will bear part of the expense of moving the main.

It is reported that the Strong Gold Mining Co. has opened a good shoot of ore by driving south from the new bottom level, about 1350 ft. below the surface.

At the Queen property in Eclipse gulch, a large quantity of medium-grade ore is being mined and sent to the Golden Cycle mill at Colorado Springs. This property was purchased by the Golden Cycle Mining & Milling Co. about a year ago. It has been idle since then until a few weeks ago.

A new concentrating plant has recently been installed at the Kitty Hollis property near the north end of the district. The whole hillside is being scraped, the material passed over screens and then washed. Quicksilver is used to save the fine free gold. From 50 to 75 tons is being treated each day.

As a result of the dry and clear weather of the past month, many of the old dumps are being worked; considerable revenue is obtained from this source. A dump-treatment plant is being constructed on the Elkton waste heaps. It will treat about 200 tons of ore per day. A steam hoist of the double-drum type, mounted on top of a 30-ft. ore-bin, operates a drag-bucket and lifts the ore to the top of the bin. Here the ore is passed through three different processes of sorting and screening.

At the Modoc property, between Battle mountain and Bull hill, sinking is in progress below No. 15 level. An ore-shoot over 200 ft. long has been opened on the level above. Development will soon be started to prove the persistency of this ore on the new lower level.

Old friends of the district will be interested in a small revival of placer mining in Poverty gulch on Cripple creek. Sluice-boxes, flumes, and the ordinary gold-pan are employed. Occasional small nuggets are found. Much of the gold is combined with iron sulphide and is not saved. Good wages are being made from the gold that is free.

The recently erected Jerry Johnson mill has proved successful in its trial run and clean-up. This plant embodies the cyanide process. In addition to dump ore, low-grade mine, and even smelting-grade ore will be treated.

DEADWOOD, SOUTH DAKOTA

Mining and Treating Gold-Antimony Ore.—Two Johns Mine.—Tailing Trouble.—Mogul Mill.—Golden Reward Roasting Plant.—Echo, North Homestake, and Hidden Treasure.

Gold-antimony ores of the Silver City district, Pennington county, are being exploited by the Home Lode Mining & Milling Co. The ores, containing gold, silver, antimony, lead, and zinc, occur in quartz veins a foot or so in width, between walls of Algonkian schist. Two of these veins are being developed on Home Lode territory; several others crop on the surface, but have not yet been opened. One of the veins has been opened by an adit 200 ft. long connecting with a shaft at the 100-ft. level. This shaft practically follows the ore from the surface to the adit level, while a winze 50 ft. deep shows the shoot to be continuous to that point. In these workings the deposit is from 12 to 18 in. wide, and about 150 ft. long. The value is mainly in gold and antimony, although assays show the presence of some silver and lead. The second vein is about ¼-mile east, and its north-south course parallels that of the first vein. Two shafts, 370 ft. apart, one 66 ft. and the other 103 ft. in depth, demonstrate the continuity of the vein for that distance. This ore-shoot is approximately 24 in. wide, and contains an appreciably greater amount of the zinc mineral, sphalerite, as well as more pyrite, than the No. 1 shoot. Treatment of the ore consists of amalgamation and concentration. Using a 7-ft. Lane slow-speed mill, with a high discharge, making a product which will all pass through a 60-mesh screen, amalgamation is done in the mill by using an excess of quicksilver. Outside amalgamation, with copper plates, has not been successful, but tests with silvered copper plates indicate that better results can be got with them. As soon as the plating can be done by the Homestake company, a thorough test will be made with the plates. A Deister double-deck slime-table has given satisfaction, making three products, namely, an antimony-lead finished concentrate, an iron-zinc middling, and tailing. Another table will be installed to re-concentrate the middling and make a zinc product that can be marketed. L. A. Richards is general manager, and L. L. Farnam superintendent.

The Two Johns mine on Squaw creek, north of Trojan, has

been leased to B. D. Hynes. He will ship ore to the Mogul mill. This property has been a producer for years, although never equipped with a mill. The dump contains a considerable amount of ore that will be profitable on cyaniding, while many of the old stopes expose remnants of shoots that should yield a profit. In former years the product was mostly of smelting grades, and in mining it considerable milling ore was untouched. For the present, Mr. Hynes will have the ore hauled by team to Crown Hill station on the C. B. & Q., a distance of a little over a mile, but should development warrant, he proposes installing an aerial tramway.

Having been forced to suspend milling ou account of the tailing polluting the waters of Bare Butte creek, the Rattlesnake Jack plant, at Galena, will be equipped with an Oliver filter, an order for the machine having been placed. The tailing from the filter will be stacked and thus be kept out of the creek.

With the newly installed De La Vergne oil-engine in use, the Mogul mill, at Terry, is treating nearly 200 tons per day; previous to this additional power installation, the capacity of the plant was only a little over half of that quantity. Further improvements to the plant, which are contemplated for the near future, include the addition of a suitable filter for dewatering the tailing. At present the mill is using a straight agitation and counter-current decantation system, the product of the final thickener going to the dump. It is proposed to filter this product. The plant is one of the most popular in the Hills for treatment of custom ores, probably due to the fact that the treatment charge has been fixed at $1.50 per ton for low-grade material.

Fifty to sixty tons daily is being treated at the Golden Reward roasting plant, at Aztec, preliminary to its cyanidation at the company's mill at Deadwood. The so-called 'bard blue' ores of the Billy and other neighboring mines, containing 3 to 4% sulphur, are given a roast at 1200°. This temperature, while it does not give a sweet roast, eliminates enough of the sulphur to make a product which yields 90% extraction in the cyanide-plant. Without roasting, these ores seldom give better than 35% by cyanidation. The ore is received in bottom-dump railway-cars which discharge to ore-bins above the crusher. From the crusher the product is elevated to a bin feeding to a Ruggles-Cole dryer. Thence it passes to two sets of rolls which reduce it to 6-mesh. It is then fed by belt-conveyor to a Wedge furnace using, as does the dryer, Wyoming crude oil as fuel. After roasting, the ore passes through coolers and is elevated to a cylindrical steel bin, from which it is drawn to railway cars for shipment to the mill at Deadwood, where it is further ground in a pebble tube-mill and cyanided. The furnace is driven by a 10-hp. motor using a litttle over 4 kw., although about twice that amount of energy is necessary to start it. Oil consumption is 13 to 14 gal. per ton of ore roasted; this oil costs, delivered, a trifle over 3c. per gal. The total costs at this plant, including crushing, drying, and roasting, are under $1 per ton of ore handled.

To provide steam for operation of the sinking pump, a small boiler has been installed by the Echo company, at Maitland. The shaft, now 175 ft. deep, will be continued to 200 ft., where an electric station pump will be used.

Two shifts of miners are employed at the North Homestake mine, at Maitland, developing a promising looking vein on the 600-ft. level.

About 60 ft. of cross-cutting has been done east and west from the bottom of the Hidden Treasure shaft. Some fair gold ore has been found, as well as a small quantity of native copper.

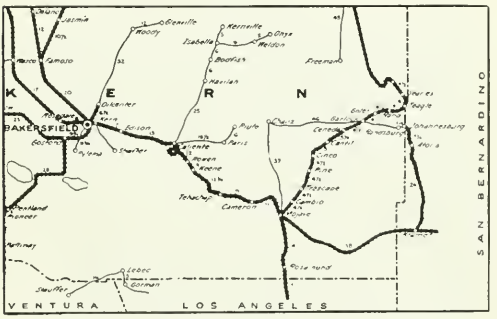
According to Charles W. Henderson, of the U. S. Geological Survey, the gold and silver output of South Dakota in 1914 was 351,865 and 172,574 oz., respectively, from 2,019,262 tons of ore. Practically all of this was from Lawrence county. Amalgamation recovered 218,644 oz. gold and 63,734 oz. silver, and cyanidation 133,221 oz. gold and 108,840 oz. silver.

ATOLIA, CALIFORNIA

TUNGSTEN MINING IN SAN BERNARDINO COUNTY: MODE OF OCCURRENCE, LEASING, STAKING, TREATMENT.

The new equipment being installed by the Atolia Mining Co. will begin operation about October 15. It includes a Marcy mill with a capacity of 100 tons per day, seven Frue vanners, and eight double-deck sand and slime concentrators, besides filtering apparatus. There are about 200 men, including lessees, now engaged in producing scheelite ore, which is all shipped to Eastern markets.

There have been several new discoveries of scheelite veins during the past year, none of which have been made on claims not owned by the Atolia company. Several miners who were leasing from this company under working contracts, by which all ore extracted reverted to the claim-owners at $3.50 to $4 per unit, have recently leased ground belonging to P. J. Osdick, and are making regular shipments of high-grade tungsten ore. Recent quotations from Eastern firms have advanced to $25 per unit, within two weeks, of 60% ore of WO_3, and even higher for better grades. An increased production has marked the recent rise in prices, and this dull little desert camp is gradually taking on the former activity of early days at Randsburg.



MAP SHOWING SITUATION OF ATOLIA AND RANDSBURG.

The desire to acquire tungsten producing mines has become keen, and the whole granite belt from the 'stringer district' near Randsburg, to Cuddaback lake is being staked by locators who load stakes into autos and cover a mile or two in a single day. The scene reminds one of the gold rush of 1896 when the St. Elmo mine (about two miles west of Atolia) was found, and locators double-staked the country on horseback. Not a little argument is shown over mining claims, though no bloodshed has resulted so far.

Tungsten is also being found near Randsburg on the Baltic, G. B., and Sunshine claims, which have for 19 years been known as gold producers. The scheelite found adjacent to these claims is in form of placer deposits, and the concentrates are usually better than 65%, which sell readily at the Randsburg stores for $1 per pound.

No more leasing contracts will be entered into by the Atolia Mining Co., and notice to this effect has been posted by the superintendent, Mr. Taylor, at the local stores and post-office. The completion of the new mill and stoppage of leasing, is the natural evolution of discoveries and development of the company's large holdings by lessees, and the output will be hereafter augmented by employees only at $3.50 and $4 per day.

Scheelite in this district occurs both in placer and fissure vein formations, which appear to be continuous, and run in an east and west direction. The richest ore is found along the spurs of nearly all veins as 'kidneys,' which vary in grade and size. Several have been found that are two to three feet wide

at depths from surface to 50 or 60 ft. As depth is attained, much of the vein matter shows alteration, and is termed 'dry bone' because of its poor quality. There are, however, several instances of over 70% ore being extracted at a depth of nearly 1000 ft. All promising veins without exception are found encased in lime at the surface, and no attention is paid to veins that are without the lime occurrence, because of this uniform peculiarity.

The production this year will be nearly 2000 tons, nearly all of which is shipped to the Pittsburg and Midvale (Pennsylvania) crucible steel companies.

Apropos of the increased capacity of the Atolia company's new mill, thousands of tons of tailing will be treated, and will keep the mill busy day and night for many months, and indirectly give employment to perhaps over 100 miners and others.

JOPLIN, MISSOURI

Floods Reduce Weekly Zinc Ore Production More Than 1000 Tons.—New Mill Building in the Oklahoma Fields.—General Activity in Zinc and Lead Districts.

Production of zinc-blende concentrate throughout the Missouri-Kansas-Oklahoma district is about 5000 tons per week at the beginning of October, compared with 6000 tons in the middle of September, the decrease being due to floods that have been general in all mining areas. In six hours' time, a rainfall of seven inches was recorded by the local weather bureau; at another time nine inches fell in the Spring City district, six miles south of Joplin, every mine in that field being filled to the surface. Great damage has been done to mining properties along Spring river, Center creek, Turkey creek, and Shoal creek, all of which streams flow through the district from east to west. Along Center creek in particular are situated many of the district's largest mines and many of these have been placed out of commission for some time. Surface waters flooded many mines that were not adjacent to any stream, and small mines have been especially heavy sufferers. Drill prospecting has been suspended temporarily, as it is impossible to carry on operations with the ground so thoroughly saturated with water. Curtailment of production has caused a brisk demand for all grades of ores; and the second-grade products that have not been in nearly as strong demand as the choicer lots for the past few months, are now commanding almost as high a basis settlement as the best grades. The range in price at the beginning of October was $70 to $80, basis of 60% metallic zinc. Calamine was in good demand at $50 to $60, basis of 40% metallic zinc, with production at low ebb, as the calamine producers felt the effects of the floods severely. Lead found a ready market at $50 per ton, basis of 80% metal.

Operations have started at the new mill of the Century Lead & Zinc Co., on an Indian lease in north-eastern Oklahoma. Two shoots of ore are mined, the lower, occurring at a depth of 190 ft., being the more extensive than the upper. A small concentrating plant of 150-ton capacity is all that is required to handle successfully the grade of ore found at this place, and this is the size of the new Century mill. The completion of this mill follows closely on the finish of the Vantage plant in the North Miami district. Steady 'turn-ins' of zinc and lead concentrates are now being made by the Vantage company. North of the Miami camp two plants are to be started soon by the Commerce Royalty Co., which already is operating several mills in the Miami field. One of the new ones, each of which will have a capacity of 200 tons, will be situated on the Blue Goose land, not far from the Century mill, while the other will be on the Beaver tract. Still farther to the north, and just south of the Kansas State line, the new work being done by the Picher Lead Co. is of much importance. Three of the eight shafts being sunk are now in ore, and work is being rushed on the remaining five. Mill construction is soon to be commenced on a big scale.

A mining area that showed some activity for several years, and which lapsed into a state of general inactivity for a number of years, until the recent increase in zinc-ore prices caused a renewal of mining operations in all districts, is the district six miles south-east of Joplin, and almost due south of the little camp of Duenweg, Missouri. On various tracts in that district new propecting work has been started, and in some instances old mines have been taken over and are now being worked. Calamine production is fairly heavy in that region at the present time, as the result of operations in shallow deposits. M. Sweetman, of Kansas City, has three good drill strikes of lead and blende at a depth of 140 ft. on the T. C. Molloy lease. The drills continued in ore to a depth of 195 ft. Molloy and associates have a new shaft in ore south-east of the drill-holes mentioned. The Mary E mine on the same land is being placed in operation. Adjoining the Molloy lease on the south is the Greenhorn tract, on which Bell & Co. are operating a recently-constructed mill, and are producing both blende and lead. South of the Greenhorn is the Knight 40-acre tract, on which some recent drilling has shown ore at various levels. On the Weymann land, still farther south, shallow calamine development is being carried on.

Along with new mill construction, the building of tailing-mills and sludge-mills is of much importance. The high price of zinc ore has made it possible to handle old tailing and sludge-ponds profitably. A new tailing-mill has just been constructed by the Martin Tailing Mill Co., on a lease of the Wysbrod land, four miles north-west of Joplin. A new sludge department is being added by E. D. Hornbrook to the Providence No. 2 mill, on the Missouri Zinc Fields Co.'s lease, south of Webb City. This plant is one of the largest in the district, having a capacity of 500 tons, and with the new sludge department added the capacity will be increased. Mining will be conducted at a depth of 190 ft. in sheet-ground.

LONDON

Cornwall Polytechnic Society.—How Cornwall Looks to the Visitor.—Problems of Tin-Dressing and China-Clay Mining.—Tungsten and the War.

Sooner or later every mining engineer makes a visit to Cornwall to see at first-hand the wonders of which he learned from the foreman at lunch-hour in the days when he was learning many things. Recently it was my good fortune to make the pilgrimage and see with my own eyes the hedges, fields, stone walls, tall stone pump-houses, and chimneys, and the buddles and rag frames in endless number and variety. I have stopped at Tabb's Hotel where the tin 'ticketings' are held, and I have descended into the depths in a shaft where levels are marked in fathoms instead of feet. The hard hat and the hand-made candles are strangers no more and I have lunched at the company-office on the good things of Cornwall. Anyone familiar with the little old towns hidden away in the valley of southwestern Wisconsin, or the tall stone-houses and massive mills of Gilpin county, Colorado (they print 'Notes from Gilpin County' in the local papers of Cornwall), anyone who has worked with the men at Grass Valley in California, will feel instantly at home in Cornwall. For that matter, from Lake Superior to Pachuca the Cornishman has left his mark on the land and an American miner from almost any district would find much that is familiar, as well as much that is fascinatingly strange, in the Old County. One difference would strike him at once, at least in these war times, and that is the small number of full-grown men in either mine or mill. Naturally they are largely at the front, for the ranks of the sapper have been recruited heavily from this district. Young boys and women are doing a proportion of work that looks odd to the American visitor. They seem, however, contented and happy, and much of the work is not hard. Tapping a tub of muddy water with a stick may be monotonous, but it is not labor too hard for the young. That is one of the phases of settling tin

concentrate that one sees on the dressing-floor. Incidentally, it may be mentioned that it calls for skill, and it is said that no mechanical tapper has been devised that gives just the right amount of regularity and variety to the blow. There are other queer but simple ways of doing things that one sees in the mills. Not the least interesting is the skillful work done with the vanning-shovel by the assayers, who use it in place of a chemical assay for most purposes. The vanning-shovel is much shallower than a gold pan, the work is done with a half-ounce sample, and the skill shown in separating the tin-tungsten minerals from the gangue is uncanny. At one large plant the mill-saving for a year checked within a trifle more than 1% of that calculated on the basis of vanning-shovel tests throughout the period. It is only, however, as a test of mill-work that the vanning-shovel is reliable. The chemical assay shows that a considerable amount of tin is lost by both shovel and mill. This loss is coming to be frankly recognized. At the recent meeting of the Royal Cornwall Polytechnic Society at Falmouth, W. H. Trewartha-James placed the loss "for purposes of discussion" at 30% and I noticed that no one

MAP OF CORNWALL, ENGLAND.

disputed the figure strenuously. One manager, who relies on chemical assays and samples the pulp from the stamps as in gold-mill practice, told me his saving was just about 70% but that he thought others did not do quite so well. Another, the manager of one of the most famous of the old mines, said frankly that he did not know what the loss was and doubted if anyone did. The matter was up for serious discussion at the meeting of the same society when Mr. Trewartha-James presented to the home-folk the paper on the 'Physical Characteristics of Cassiterite in Cornish Mill-Products' by the late J. J. Beringer, read before the Institution of Mining & Metallurgy last May. Beringer, who was Principal of the Camborne School of Mines, made a special study of the 200-mesh mill-products and concluded that below a certain definite size it was impossible to settle them in water economically and that it was here that the loss occurs. These conclusions seem to be generally accepted and it is now proposed to study (a) the size of the cassiterite particles in uncrushed ore, (b) methods of crushing to avoid sliming, (c) special methods of treatment, such as leaching, for treating the slime unavoidably made. A resolution was passed by the Polytechnic Society inviting the Institution to co-operate in a thorough scientific study along these lines. It is believed that something definite and practical will come from this work. Another similar proposal was that the Polytechnic take the lead in studying the technology of mining and preparing china-clay for the market. This has become a great industry in Cornwall, usurping a place formerly held by copper mining. The country consists of a great peneplaned upland of ancient phyllites and graywackes or 'killas' as they are locally called, above which rise monadnocks representing granitic stocks intrusive into them. In the killas around these stocks the copper veins are found and as these were worked down and into the granite, tin was found to replace the copper. On the other side of the contact and in the granite are great softened areas out of which the china-clay is dug. It is really granite, altered, probably by thermal solutions but possibly by weathering, and the clay is pumped rather than dug. Water is led down into the pits over the face of the bank, or is piped down and played against it in small weak streams, while the milky white pulp, containing about 2% solids, is pumped to the surface. The sand left behind is trapped in the pit and dug out by ordinary shovel and tram-car work. The clay-bearing pulp, which contains an amount of white mica equal, roughly, to the clay, is led through settling-troughs and pits till the mica is disposed of and then through earthen pipe-lines (as much as six miles) to the 'drys.' Here it is settled out of the water and finally dried over long furnaces roofed with fire-clay tile and in part with aluminum. Iron cannot be used in the process for fear of rust spoiling the color of the clay. These various methods and the chance of improving them were described by J. M. Coons and discussed at some length before the Society. The first impression on visiting a clay-pit is that the methods are crude and susceptible of much improvement, but they are effective and simple, and it is not so certain that many changes could be made advantageously. Stephen Vivian pointed out that it was all wrong mechanically to drop 98 tons of water into a pit and pump it out again to get two tons of clay, since in the end the quartz and refuse had to be mined anyway. A simpler plan would seem to be to mine the whole material and then wash out the clay at the surface. Possibly something of that sort may be done in time. The pit of the North Cornwall China Clay Co., which I visited, is about 6 acres in extent now, and 100 ft. deep. The clay extends at least another hundred feet in depth—how much more is not known. Temporarily the china-clay miners are much disturbed by restrictions on the shipment of material out of the country, but through a term of years the industry has grown handsomely. Another interesting paper was presented to the Polytechnic by J. H. Collins on the occurrence of tin and tungsten in Cornwall. Mr. Collins had listed all the localities in which tungsten had been found, a service particularly valuable just now when tungsten is in demand. The tungsten producers are under the control of the new Munitions Ministry, which has reserved the right to take all the product at a fixed price of 55s. ($13.20) per unit. As a matter of fact, they are allowed to supply regular customers so long as there is no shortage or delay of more than two weeks in Government orders. In this other direction the new system of controlled industries is working fairly well and the confusion of last winter is disappearing rapidly. England has been a land where every man's house was his castle and his shop was his fort but now that the whole strength of the nation is needed for war purposes the Government has taken possession and a new system of ordered and co-ordinated industry is being built up which will be worth much to the country in peace as well as war.

GOLDFIELD, NEVADA

ORE TREATMENT.—KEWANAS.

A 30-ton flotation plant is to be erected at the Goldfield Consolidated mill, where experiments have been under way for some time, devising a process to treat the gold-copper ores of this and other local mines.

Development in the Kewanas, where commercial ore was exposed near the shale at a depth of 840 ft., has shown that the true shale-contact zone has not yet been reached.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Juneau

The August return of the Alaska United is as follows: 270 stamps crushed 45,290 tons of ore yielding $72,240 from amalgamation and cyanidation of 964 tons of concentrate. The loss was $1311, construction costing $16,609. The ore yielded from $1.27 to $1.96 per ton.

The Alaska Juneau company is defendant in a suit by the administrator of the estate of R. Milatovich for $25,000 damages. It is alleged that the deceased fell into an uncovered winze, and died as a result of the accident.

ARIZONA

Cochise County

Extensive development continues in the Warren district.—— A new head-frame and double-drum electric hoist have been erected at the Uncle Sam shaft of the Copper Queen mine. A drift, 1600 ft. long, is to be started at 400 ft. depth between the Czar and Uncle Sam shafts. Good ore is being opened at 1600 ft. of the Sacramento division. Material for concreting this shaft is arriving, and work will soon be commenced. Good sulphide ore has been cut at 1100 ft. in the Lowell section. The Gardner is the busiest part of the property.

Lessees in the district are doing well, especially the Higgins Leasing Co.

Good copper ore is being opened from 200 to 800 ft. in the Shattuck-Arizona, also lead ore at the latter depth.

Gila County

At the Inspiration over 5000 tons of ore is being hoisted daily, the total for September being approximately 100,000 tons. Four sections of the mill are fitted with flotation machines of the Callow type, and four others will soon have the Inspiration type installed. Residue is conveyed to Ellison canyon, between the mill and smelter. At the power-plant one of the three 6000-kw. turbo-generators is working.

The Gibson mine is producing about $25,000 worth of copper ore per month. There are 81 lessees producing 30 cars of 20% ore per month. Other mines in the district are busy.

Greenlee County

The sequence of events concerning the miners' strike at Clifton are as follows: The general managers of the Arizona, Detroit, and Shannon companies replied to the leaders of the Western Federation of Miners on September 26, stating that a few agitators had led out many men who were satisfied with conditions, and that as long as the Federation had any influence in the district the mines and works would be closed indefinitely. In February this union called a strike at Miami, and another at Ray in July. According to Walter Douglas of Phelps, Dodge & Co., the Federation is trying to secure political domination of the State. Americans at Clifton receive the same wages as at other centres, as also the unskilled Mexican employees, but the latter cannot expect as much as the Americans. The wage dispute is only a wedge to unionize the districts.

On September 27 the governor of Arizona, W. P. Hunt, went to Clifton from Phoenix to investigate the dispute, the result of an appeal by the sheriff of the County. The Governor heard both sides of the trouble. The managers were insistent that the Federation be kept out of all arguments. The town is quiet. No pumps are working at the mines, so water is rising in them.

On October 2 the general managers of the three companies left by special train for Lordsburg, New Mexico, their destination being unknown. They feared personal violence, as the master mechanic of the Arizona Copper Co. was roughly handled, and the situation was grave. The militia is ready for any trouble that might arise.

It is stated that a minimum wage of $3.50 per day is demanded for miners, and $4.25 for mechanics, based on 13-cent copper, with an upward sliding scale for increased prices.

CALIFORNIA

Amador County

The Marsino mine at Volcano is to be prospected by diamond-drilling.——Ore from O. M. Henry's claim in this district is being hauled to the Central Eureka mill at Sutter Creek.

Butte County

The Noble Electric Steel Co. has bonded some manganese-iron ore deposits 1½ miles from Clipper Mills from the owner, G. W. Woolley. Ore will be tested at Heroult, Shasta county.

Eldorado County

Mining timber for Plymouth, Amador county, is being supplied by forests at Mt. Aukum, Fairplay, and Indian Diggings. A number of teams are busy hauling the logs.——In the suit over the lime deposits three miles north of Salmon Falls, the Holmes Lime Co. has received a clear title to them.

Kern County

A 40-hp. gas engine will probably be ordered for the Skidoo Mines Co.'s mill at Skidoo. Hot weather has affected the water-pipe, resulting in leaks and delays in treatment.

The Wild Rose mine is shipping 25 tons of antimony ore daily.

Nevada County

On September 30 the North Star Mines Co. paid 20c. per share, equal to $50,000. The total for this year is $150,000, and $4,687,040 to date.

The North Star company is to deepen the Providence shaft of the Champion property at Nevada City; the shaft, an incline, is being re-timbered and a new track laid. Sinking will commence from 1750 ft. A new electric pump and hoist are being installed. This shaft will eventually be the main outlet for the property.

Last week the Golden Center company at Grass Valley gave its employees a day off on full pay, and dined them well. This was on account of the end of threatened litigation and the opening of good ore.

At the Central-South Yuba mine some good copper ore is being developed at 100 ft. depth. A shipment has been sent to the Selby smelter.

Placer County

The Spreckels interests have bonded the Mason tract, containing limestone deposits, at Applegate. One thousand tons will be extracted for testing purposes.

Developments at the Herman mine at Westville continue satisfactory, and the 30-stamp mill is busy on good ore from the 300-ft. level.

Trinity County

Seattle people have been examining the asbestos claims of B. Kellogg, 12 miles from Hayfork.

It is reported in Montreal, Canada, that the Crown Reserve Mining Co. of Cobalt is negotiating for control of the Globe gold mine, which has produced $250,000 to date.

Tulare County

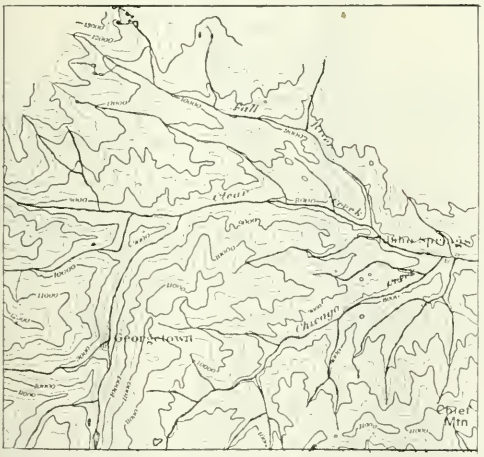
(Special Correspondence.)—The Mineral King district, an area of over 20 sq. miles, at an altitude of 8000 ft., and three miles from the Seqnoia National Park, is worth the attention of mining men with capital. It is an old district, but at present only a few men are working, most of the operations being done by W. F. Cord and T. J. Crabtree, who control 13 claims. At a depth of 30 ft. they are opening high-grade lead-zinc-silver ore. The area is highly mineralized. The lodes occur in limestone and quartzite. East and west of the district is granite. The properties are 38 miles from the railway at Lemoncove. A good automobile road is to be built next year.

Mineral King, October 1.

COLORADO

Clear Creek County

It is alleged that the water supply of Georgetown has been polluted by the residue from the Waldorf mill and cyanide-plant at East Argentine, and a temporary injunction against



TOPOGRAPHY OF THE GEORGETOWN-IDAHO SPRINGS DISTRICT. (U. S. G. S.)

the owners, the United Imperial Mines Co., has resulted in the works being closed. The company's vein in the Waldorf mine pinched recently, but now shows 24 in. of ore. It is 80 ft. long. Lessees at the Waldorf are getting satisfactory results.

Lake County (Leadville)

Leadville is busy at all points. Water in the Penrose shaft is two feet below the old 600-ft. level, from where all the larger stopes of the property were opened. The heaviest part of the pumping is finished. The shaft is in good condition, but the station has caved badly.

At the Bwlgocogh gold mine there are 25 men employed under S. G. Wightman. The mill is treating from 40 to 50 tons daily. The mine is worked by adits, and the main vein has been opened for 900 feet.

Ouray County

During August the Camp Bird mill treated 2787 tons of ore for a profit of $43,000.

Park County

Part of this county, near the boundary of Lake county, is attracting a good deal of attention. The roads from Leadville are not what they might be. Leadville people have leased several claims near the London mine.

Summit County

Several discoveries have been made in the Breckenridge district lately, and about 25 men are prospecting. No. 2 dredge of the Tonopah Placers Co. exposed some veins during its work.

IDAHO

Bonner County

Although the Priest River district is 30 miles from the nearest railroad, yet considerable activity exists. Miners think that the ore will stand the expense of this long haul.

Shoshone County (Coeur d'Alene)

The new 10,000-ft. aerial tram of the Interstate-Callahan is finished. It connects the mill with the Nine Mile branch of the Northern Pacific railway, a fall of 800 ft. Thirteen four-horse teams are now used to haul ore and concentrate; they will be dispensed with, and an estimated daily saving made of $250.

A 4000-ft. adit is to be driven into the Oom Paul mine, 1½ miles from Burke. The old 500-ft. adit in the Echo will be used.

A mill is to be erected at the Northern Light Mining Co.'s property on Pine creek, near Kellogg. B. G. Harmon is managing owner.

On October 4, the Bunker Hill & Sullivan Co. paid dividend No. 217, of $81,750. This makes a total of $16,527,750.

Over 60 mining and business men of Spokane visited the Coeur d'Alene districts at the end of last week.

The Bunker Hill & Sullivan company is making good progress in securing damage releases from property owners at Kellogg, in connection with the smelter to be erected there.

When several alterations have been made at the National copper mill, about October 15, the plant will start again. The bins are full of ore, and recent developments have exposed a large quantity.

The Ray Jefferson company is to construct a 250-ton mill next spring to treat the zinc ore being opened. David C. Smith is president at Missoula, Montana.

A shoot of high-grade zinc-lead ore has been cut in the Little Pittsburg on Pine creek, owned by G. Smith.

During changes at the Frisco mill, the property will be closed. Recovery of the zinc has not been satisfactory.

The Northport Smelting & Refining Co. was organized at Wallace on September 25. The directors are as follows: president, Jerome J. Day; Edward Boyce, E. R. Knight, F. M. Rothrock, and Eugene R. Day, the latter being secretary. Overhauling of the plant in Stevens county, Washington, is making good progress.

MICHIGAN

The Copper Country

Up to the last week of September the shipment of copper by boat from the region was 25,000 tons greater than the same period of 1914.——The Calumet & Hecla sand dredge and regrinding plant is working at near capacity. Six additional Hardinge mills were started last week.——The electric haulage-plant on No. 36 level of the Franklin is working satisfactorily.——In the new Isle Royale mill a sprinkling system has been installed to cope with possible fires.——The burned shaft at the Centennial has been repaired, but the rock-house is only partly re-built.

On September 24 the White Pine mill produced 52,000 lb. of mineral averaging 70% copper, a record, but the plant was not at full capacity.

MISSOURI

Jasper County

Joplin was visited on September 26 by 2.4 in. rain, making 55.14 in. for the year. No damage to mines was reported, as was the case three weeks ago.

The wage question is being considered by mine operators of the district, and the schedule is based on the average basis price of blende. The owners are not taking into account the actual low basis price in settling the monthly average.

MONTANA

Granite County

The Granite-Bi-Metallic company, of St. Louis, operating at Philipsburg, is to meet and decide on the future of the property. There is said to be $300,000 on hand for work or dividends.——The Royal gold mine has been optioned to Chicago people. It is fairly well equipped, including a 20-stamp mill.

Silverbow County

As copper averaged over 17c. per pound during September, miners in the Butte district will receive $4 per day, instead of $3.75 in August.

A good deal of development is under way at the smaller properties at Butte, including the Butte and Great Falls, Emma, Eveline, Butte and London, Jennie Dell, Nettie, Tropic, Rainbow, and Tuolumne.

In the argument as to whether the Butte-Duluth company was bankrupt, Judge G. M. Bourquin of the Federal Court at Butte dismissed the suit of creditors. Wages due amount to about $40,000. Other creditors, owed $200,000, did not wish the company declared bankrupt. The company wanted a receiver appointed, which was done, but not to be declared bankrupt.

NEVADA

Esmeralda County

The estimated production of the Goldfield Consolidated Mines Co. in September is as follows:

Ore mined, tons	32,500
Gross extraction	$269,000
Operating expense	$159,000
Net realization	$110,000

Some rich ore has been discovered at 440 ft. in the Laguna mine of the company, near the most northerly point where profitable ore has been found in the property. Details are not available yet.

Humboldt County

At 1200 ft. in the Seven Troughs Coalition there is 18 in. of ore assaying $10,000 per ton. The previous day there was 8 in. of $5300 ore showing. A winze is being sunk below 1400 feet.

The Friedman adit at the Rochester Mines property is in 1030 ft., and is progressing at the rate of 15 ft. per day. At that point 7 ft. of $11 to $30 ore was cut on October 3. Other parts of the mine are looking well. The September output of the mill will be about $40,000.

Nye County

Mines at Tonopah last week produced 9496 tons of ore valued at $196,888.

At 1020, 1100, 1170, 1260, and 1350 ft. in the Extension a wide lode is being developed, up to 18 ft. at 1100 ft. The new thickener in the mill will soon be finished.——A raise above 1166 ft. in the Belmont is showing better ore than previously. ——The Tonopah Mining Co. did 454 ft. of new work during the week.

Storey County

On the Comstock the Ophir and Con. Virginia have completed installing plant at the 2700-ft. winze. A station is being cut at the bottom, from which cross-cutting will proceed. The Ophir is to sink a winze below 2500 ft. From this depth the Union Con. is extracting good ore. The Mexican and Sierra Nevada are working at 2500 and 2700 ft. and 2500 ft. respectively. At Gold Hill the Jacket-Crown Point-Belcher Mines Co. continues work at 1600 ft. of the Crown Point-Belcher incline.

UTAH

Beaver County

New York capital has taken a hand in development of the Majestic mine, which produces copper ore. One shaft is down 400 ft. in good ore, and will be deepened; while the Hoosier shaft will be sunk from 460 to 1000 ft. Some ore is being shipped.

Boxelder County

The American Metal Co. has secured an option on the property of the Lake View Mining Co., at Promontory point, near Great Salt Lake, 24 miles west of Ogden. The price is said to be about $625,000. The mine contains high-grade zinc ore, and 48 cars have been shipped since last spring, returning up to $18,000 per car.

Juab County

The Tintic district produced 129 cars of ore last week.

Construction of the Tintic Milling Co.'s 300-ton plant is employing 75 men. It is hoped to complete it in January. Ore from the Knight mines, lessees, and dumps will be treated, using the Holt-Dern and Knight-Christensen processes.

At a depth of 40 ft. a shaft at the Yankee Consolidated cut ore, and a drift shows 5 ft. assaying 120 oz. silver, $8 gold, and 37% zinc. The discovery is the cause of considerable comment at Tintic.

Lessees at the Gemini shipped 1500 tons of $25 ore in September. The company has lowered the water to 1700 ft. depth.

CANADA

British Columbia

According to Oscar Lachmund, general manager of the British Columbia Copper Co., $1,000,000 will be spent in development and plant at its properties. A 2000-ton concentrating-plant will eventually be erected at the Copper Mountain mine, driven by a large power-plant at Coalmont or Princeton, and possibly a 9-mile aerial tram. Reserves at Copper Mountain are estimated at 8,000,000 tons of 1.75% copper ore. Extensive diamond-drilling has been done, and regular development is soon to commence. Three drills at present are boring 33 ft. each daily. At the Greenwood smelter one furnace is reducing 860 tons per day, including some custom ore.

Tests having been made of the Silver Hoard ore, near Ainsworth, a 50-ton concentrating-plant is to be erected. A power-plant is to be built on Cedar creek.

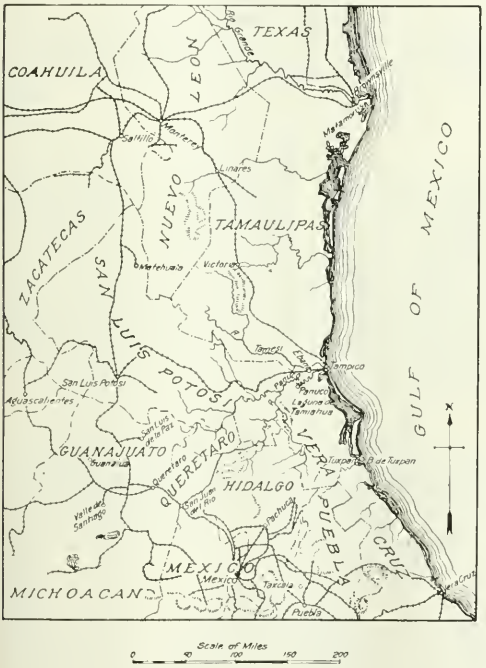
MEXICO

(Special Correspondence.)—Mining conditions are much improved in comparison to those of a few weeks ago, according to H. H. Allison, superintendent of transportation for the American Smelting & Refining Co. in Mexico. Mr. Allison came here from Chihuahua and Parral, *via* El Paso, a few days ago, on his way to visit Monterrey, San Luis Potosi, and other interior towns and mining districts of Mexico, as soon as train service is re-established. He says that as soon as he can make an inspection of the various plants of the A. S. & R., and provide means for supplying them with fuel and ore, they will resume operation. The recent exodus of American smelter employees and mining men from the Villa territory in Chihuahua caused the Company to shut down its smelter at the city of Chihuahua. The smelters at Monterey, Matehuala, and Aguas Calientes were closed some time ago, but Mr. Allison says that they will all re-open in a short time, and if the railroads are able to handle the fuel, the plants will be operating full time within the next 30 days.

Laredo, Texas, October 1.

The oil region of northwestern Mexico is discussed by V. R. Garfias in Economic Geology for April-May. The paper covers 28 pages, dealing with the topography and water supply, geology, origin of the oil, development, market conditions, production, transportation, storage facilities, refineries, and future development. Little has been published regarding the geology and occurrence of oil in Mexico. This paper is based on personal investigation by Mr. Garfias. The greater part of the petroliferous area lies in the state of Vera Cruz, only a northwest fraction being in San Luis Potosi. The centre of supplies for the oilfields is Tampico, where loading facilities are excellent. The oil area is from 20 to 40 miles south of Tampico. Transport of supplies is facilitated by estuaries and

streams. The first wells were drilled in 1882 near San Juan Bautista. The estimated output in 1914 was 27,000,000 bbl. Lack of adequate means of transporting oil from the wells to market has hindered successful operation of entire districts. The quality of the oil, and the distance of the field from Tampico and Tuxpam are factors controlling transport of the oil. The Ebano and Panuco districts' oils cannot be economically pumped through pipes. The former is used for asphalt and fuel by the Mexican railroads. The Panuco oil, however, is exported, and has to be barged about 60 miles by river to Tampico, where it is stored before delivery to tank steamers. On account of its viscosity this oil has to be heated twice. From the Huasteca and Portrero fields the oil is pumped to



PART OF MEXICO, SHOWING OILFIELDS.

Tampico and Tuxpam respectively through 8-in. pipes. Large tank-steamers are loaded in quick time, especially at Tampico. Storage facilities of the region totals 15,000,000 bbl. There are refineries at Tampico. Mr. Garfias regards the Mexican oil industry at present as only in its infancy.

In Bulletin 104 of the A. I. M. E., L. G. Huntley of Pittsburg, also discusses the Mexican oilfields in 41 pages. The history of development and production are dealt with, details of operating companies given, and geology and future are discussed. Potentially Mexico is thought to be the second greatest oil-producing country in the world.

In the same publication the Furbero oilfield, lying in the gulf coastal plain of Mexico between Tampico and Vera Cruz, in the state of Vera Cruz, is described by E. Degolyer. The deposit is of a type hitherto unknown. The area was one of the earliest known oil regions in the Republic. It is mostly covered with dense tropical jungle and a mantle of soil resulting from centuries of vegetable decay. The oil occurs in commercial quantities in igneous and metamorphosed rocks.

Hidalgo

During August the Santa Gertrudis made a profit of $25,000 from 13,338 tons of ore.

PERSONAL

C. S. Herzig is in Colorado.

H. H. Webb is at Los Angeles.

Ernest R. Woakes is in Spain.

Ben. S. Revett has gone to New York.

C. T. Durell has returned to Los Angeles.

John B. Hastings has been on a visit to Pittsburg.

R. M. Raymond has gone from El Paso to New York.

Philip R. Bradley has returned to Treadwell, Alaska.

J. Parke Channing is expected shortly in San Francisco.

Desaix B. Myers has returned from Colorado to Los Angeles.

H. L. Payne, of Baverstock & Payne, is at Yerington, Nevada.

G. Hildick Smith is now manager of the Ferreira Deep, on the Rand.

R. B. Lamb now has his office at Room 1615, 27 Cedar street, New York.

L. B. Eames is now mill-superintendent to the Hollinger Gold Mines, at Porcupine.

Corey C. Brayton has returned to San Francisco from a season's work in Alaska.

John R. Farrell is directing work at the Dean mines, near Battle Mountain, Nevada.

William Tr'ran left San Francisco on October 3 for New York, on his return to London.

Paul Selby, formerly at the Ferreira Deep, has been appointed manager of the Nourse Mines, at Johannesburg.

S. R. Coghlan has returned from Peru, having resigned as assistant superintendent at the smelter of the Cerro de Pasco.

J. D. Connor, representing the South Australian government in an enquiry into the leaching of copper ores, is now in California.

R. H. Stewart, general manager of the Consolidated Mining & Smelting Co., British Columbia, has been to Ottawa in connection with the zinc smelter to be erected at Trail.

A. L. Queneau has received the Distinguished Conduct Medal and also the French Cross of War. His eyes were injured while fighting at Ypres, but he has fortunately recovered.

George H. Garrey, of New York, formerly with the U. S. Geological Survey, has just completed a geological study of the Merger Mines property and surrounding territory at Goldfield, Nevada. His report will form the basis of future development plans of that company. Willis Lawrence has been appointed general manager for the Merger company.

Schools and Societies

The two weeks' field work in geology required of the students in mining and metallurgical engineering at the Carnegie Institute of Technology, Pittsburg, was conducted in the anthracite region of eastern Pennsylvania, in the vicinity of Hazleton, and at Franklin Furnace, New Jersey, during the early part of September. The party was in charge of Charles R. Fettke.

The Yale Engineering Association has recently been organized among graduates of Yale University. The present membership is nearly 500. Any Yale graduate is eligible, but those who are engaged in engineering pursuits are naturally more interested. The object is to assist work at Yale, and establish helpful relations between Yale engineers. The first meeting will be held at New Haven early in November. The secretary is R. T. Dana, '96 S.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, October 7.

Antimony	32
Electrolytic copper	19
Pig lead	4.75—5.70
Quicksilver (per flask)	$90
Spelter	16
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	26

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, October 7.—Copper is quiet and easier, showing no change all the week; lead is dull but steady; zinc is erratic and weak.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Sept.	30	Aug. 25	16.27
Oct.	1	Sept. 1	17.83
"	2	" 8	17.62
"	3 Sunday	" 15	17.42
"	4	" 22	17.75
"	5	" 29	17.87
"	6	Oct. 6	18.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended September 18 amounted to 13,495,959 lb., valued at $2,578,709. Of this, 4,158,697 lb. went to France, 4,092,010 lb. to Italy, 2,295,029 lb. to England, 1,166,080 to Russia in Europe, 1,120,318 lb. to Sweden, and 257,286 lb. to Holland. Imports totaled 3,139,266 lb., worth $468,293. Canada contributed 1,920,799 lb., Chile 521,800 lb., and Peru 395,445 pounds.

The production of Michigan mines in September was about 25,000,000 lb., the large properties yielding the same as in August. The Calumet & Hecla and its subsidiaries are at full capacity and no more crushing power is available. The Champion company is paying $2 per share, making $23 for the current year.

August outputs were as follows: Chino, 6,640,923; Nevada Consolidated, 6,201,858; Ray, 5,779,489; and Utah Copper, 15,966,543 lb. The first two were small decreases, while the latter two were increases of 1,300,000.

The Miami is now producing at the rate of 65,000,000 lb. per year, and should make a net profit of $500,000 over the $4 per share dividend.

In the year ended June 30, 1915, the Granby Consolidated's profit was $929,165, from 25,746,059 lb. sold at 15.87c. per pound. The two properties are now producing at the rate of 42,000,000 lb. per year, the full capacity.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept.	30	Aug. 25	47.08
Oct.	1	Sept. 1	46.77
"	2	" 8	48.20
"	3 Sunday	" 15	48.56
"	4	" 22	48.85
"	5	" 29	49.29
"	6	Oct. 6	49.64

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47 52
Feb.	57.53	48.45	Aug.	54.35	47 11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec	49 27	....

The undertone of the silver market continues to be good. On October 2, $493,960, say 1,000,000 oz., was shipped from San Francisco to China. Stocks at Bombay, India, are large, and it is not considered likely that that country will buy much in the immediate future. It is thought in some quarters that the reduced amount of gold being sent to India should have a favorable effect on the demand for silver, but Bazaar purchases lately have been small. Imports of silver into England during August totaled £532,350 (5,500,000 oz.), and exports from that country, £686,475 (7,000,000 oz.).

The Calumet & Hecla company is now recovering a good deal of silver from the refining of its copper at Hubbell, Michigan.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Sept.	30	Aug. 25	11.96
Oct.	1	Sept. 1	15.75
"	2	" 8	14.77
"	3 Sunday	" 15	13.92
"	4	" 22	13.58
"	5	" 29	14.23
"	6	Oct. 6	14.37

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

On October 11 the New Jersey Zinc Co. pays an extra 2% dividend. In August the Butte & Superior made $4.50 net per share.

Continuous rain has affected production in the Missouri-Kansas-Oklahoma zinc region. Prices for ore were stronger during the week ended October 3. The output was 6719 tons blende, 348 tons calamine, and 969 tons lead, averaging $80.57, $53.28, and $51.08 per ton respectively. The total value was $610,549.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Week ending	
Sept.	8	95.00	Sept. 22	90.00
"	15	90.00	" 29	90.00
			Oct. 6	90.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38 60	90.00	Dec.	53.10	....

Quicksilver in London is quoted at £16 ($76.80) per flask.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.			Average week ending	
Sept.	30	4.50	Aug. 25	4.49
Oct.	1	4.50	Sept. 1	4.87
"	2	4.50	" 8	4.90
"	3 Sunday		" 15	4.63
"	4	4.50	" 22	4.50
"	5	4.50	" 29	4.50
"	6	4.50	Oct. 6	4.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5 75	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

On October 6 tin was strong at 32.75 to 33.25c. In London it is £151 7s.6d. to £152 15s. per ton.

MINING DECISIONS

Oil Lease—Payment of Rentals

Where an oil and gas lease provided for rentals of "50 cents a day until the well was commenced," these words were held to fix the rate and not the time of payment, and payments at reasonable intervals for default in drilling the well were sufficient to preserve the lease against forfeiture.

Smith *v.* Steele (Kansas), 150 Pacific, 519. July 10, 1915.

Oil Lease—Recovery of Rentals

Under an oil and gas lease providing for stipulated rentals in lieu of royalties if the lessee fails to drill wells, the lessor is entitled, upon failure of the lessee to pay the rentals, either to forfeit the lease or to waive forfeiture and sue for the rentals.

Cohn *v.* Clark (Oklahoma), 150 Pacific, 467. June 29, 1915.

Gas Lease—Assignee's Liability for Royalties

Where an oil and gas lease provides for an annual royalty on the gas produced and marketed, and the lessee operates the lease, marketing the gas for a portion of the year, and thereafter assigns the lease, the assignee, in the absence of a special contract, is not liable for the royalties accruing on wells the product of which was marketed prior to the assignment, regardless of when the royalties became due and payable, but is liable for such royalties as may accrue during the time he markets the product.

Columbus Gas & Fuel Co. *v.* Knox County Oil & Gas Co. (Ohio), 109 Northeastern, 529. October 13, 1914. (Not previously reported.)

Mining Locations—Conveyance—Warranty

An option agreement was made for the purchase of a certain group of mining claims—some patented, others unpatented—and deeds of conveyance were placed in escrow. After some payments had been made and development work done by the intending purchaser, the Government refused a mineral patent to a number of the unpatented claims on the grounds that the minerals in the ground had been exhausted. Thereupon the purchaser brought suit to rescind and recover payments already made on ground that the vendor had failed to make title. Held, that the parties in dealing with unpatented claims were dealing solely upon the basis of a possessory right subject to defeasance by the Government, and that there was no breach of warranty.

Trinity Gold Dredging & Hydraulic Co. *v.* Beaudry (California), 223 Federal, 739. May 24, 1915.

Annual Labor—Forfeiture by Co-owners

In 1910, E. Thompson, together with Thomas W. Pack and others, located 175 placer mining claims on the potash deposits at Searles lake, San Bernardino county, California. In 1914, Thompson served upon Pack and the other co-owners the notice of forfeiture provided for in Section 2324, Revised Statutes, for failure to contribute to the expense of assessment work. Thereupon Pack and the others sued for an injunction restraining Thompson from declaring the forfeiture, alleging that the notice was insufficient on its face, as it showed that Thompson himself had only spent $5600 in assessment work during the years 1911 and 1912, whereas $35,000 was required by the statute. Held, that the injunction should issue. A co-owner is entitled to declare a forfeiture under the provisions of Section 2324 only when he himself has fully complied with the requirements of the statute in performing his annual labor on the claims.

Pack *v.* Thompson (California), 223 Federal, 635, 641, 642, 643, 645. May 24, 1915.

BOOK REVIEWS

Manual del Ingeniero. Por John C. Trautwine, revisado por John C. Trautwine, Jr. y John C. Trautwine, 3rd. Traducido de la 19a edición (1913) y convertido al Sistema Métrico, por A. Smith. P. 1272. Ill. Paris. Casa Editorial Garnier Hermanos. Received from Trautwine Company, Philadelphia. For sale by the Mining and Scientific Press. Price, $5.

This is a translation of Trautwine's remarkably useful handbook for engineers. The publication of this Spanish 'Trautwine' places the Spanish-speaking engineer in touch with the great progress made by the English-speaking engineers and will be of great benefit to both. The typography and arrangement is the same as in the English edition. An excellent feature is that all weights and measures are given in both the metric and the English system. It hardly seems possible that such experienced publishers could issue this handbook without an index, but such is the lamentable fact.

The Mineral Industry. Edited by G. A. Roush. Volume XXIII. P. 998. Ill., Index. McGraw-Hill Book Co., Inc., New York, 1915. For sale by the Mining and Scientific Press. Price, $10.

Recent enquirers for this valuable annual work of reference and study of a great industry will be pleased to know that it is to hand. It was thought that the conditions existing would have curtailed the scope of the book, but we find that beyond the fact that the War made it difficult, and in some instances impossible, to obtain data, the number of pages is only twelve less than the previous volume. Metals and minerals are discussed alphabetically as usual, statistics are on previous lines, and leading journals have been drawn on for current technology. The lists of State Geologists and State Mine Inspectors will be found useful to those requiring information on progress in the States. 'Readjustments in the Mineral Industries,' an introduction by George Otis Smith, director of the U. S. Geological Survey, is in line with his 'Our Mineral Reserves,' how to make America industrially independent, published soon after the War started last year. The chapters on copper, gold and silver, lead, and zinc, of 126, 57, 94, and 35 pages, respectively, total a little less than those in Volume XXII, but are replete with the latest data and treatment processes. Great interest is now being taken in the rarer minerals, as many are not available from foreign sources, and those connected with non-metallic products will find the latest in this work. Important new chapters are as follows: 'The Flotation Concentration of Ores,' 'The Smoke Problem in the Mineral Industries,' and 'Refractory Materials.' The first is merely a summary of this new system of treatment, and current articles in the technical journals, such as the Press is publishing, must be read to keep up to date. Smoke and fume are dealt with by an expert, F. G. Cottrell. Fifty-one well-known engineers contributed to the varied information in the volume.

Mineral Resources of Minas Geraes (Brazil). By Albert F. Calvert. P. xi., 100. Ill., maps. Spon & Chamberlain, New York, 1915. For sale by the Mining and Scientific Press. Price, $2.

Brazil is rich in iron resources; nearly half of the book is devoted to repeated descriptions of these thinly embedded hematite and magnetite deposits. The total amount of iron ore available is enormous; individual deposits contain hundreds of millions of tons, while the whole district contains many billions of tons and "probably not far short of the total reserve of available ores in the Lake Superior region today (1911)." This is the statement of the author, but we find in 'Mineral In-

dustry' for 1913 that the iron ore deposits are estimated to contain 7500 billion tons, or three times the tonnage credited to the Lake Superior region; the quality is said to be better. In spite of these vast resources of iron ore of the finest quality, the production of iron in Brazil is so small that it is not mentioned in any of the ordinary works of reference. The book also treats of the gold mines of Minas Geraes; the most important mine is the Morro Velho of the St. John del Rey company; this mine has been worked continuously since 1834, producing 5,590,608 tons of ore with a gold yield of $54,771,375, from which $11,166,471 has been paid in dividends. The diamond and mica mines are briefly mentioned. We note an error in the statement that the mica mines in India are from 35 to 70 miles from a railway; those of Nellore are only a few miles away, and as the country is level, transport is cheap. The absence of an index, table of contents, parallels of latitude and longitude on the maps detract from the value of the work. In a book written for English readers an explanation should have been given of the monetary units employed; a bibliography should have been added. We find the book exasperating. The author evidently knows much about the subject and conld have easily written a valuable work instead of this meagre sketch. The 118 photographs and 10 maps are fully as interesting as the text.

UNITED STATES MINING STATUTES ANNOTATED. By J. W. Thompson. Bulletin 94. Law Serial 4. In two parts: (1) 'Sections and Statutes Relating to Metalliferous and Coal Mining'; and (2) 'Miscellaneous Mining Subjects.' P. 1772. Index. U. S. Bureau of Mines, Washington, D. C. Orders should be sent to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $2.50 for cloth binding. Not sold separately.

This bulletin is a compilation of all sections of the United States Revised Statutes and of all acts of Congress relating to mines, mining, mineral lands, and the mining industry on the public lands. It is intended for persons engaged in mining enterprises that come within the scope of Federal mining laws and as a guide as to the determination of mining rights and duties. It shows the status of every Federal mining law, both laws relating to metal mining and those relating to coal, oil, and phosphate, and to mining on public, Indian, and railroad lands.

The bulletin relates only to the United States mining laws and does not include any of the laws of the different states in regard to mining. Another bulletin which the Bureau hopes to print in the future will contain the state laws.

In addition to the Revised Statutes and the acts relating to metal, coal, and oil and gas, acts relating to the following subjects, as they bear upon the mining industry are included: Alaska, Indian Lands, Lead Mines, Philippine Islands, Pipe Lands, Railroad Grants, Rights-of-Way, Salines and Salt Springs, Settler's Relief Acts, State and Public Grants, Stone Lands, Timber Cutting for Mining Purposes, Town Sites, Tunnel Acts, and Withdrawals.

All sections and acts are annotated. These consist of abstracts of decisions of all courts and public officers wherein any of these sections or statutes are explained, construed, and applied. The annotations are arranged under each section or statute with appropriate title lines in definite order, and consist of plain propositions of law, and point out how the courts have cured many defects, made clear the uncertainties, and aided in the practical application of these statutes. The large number and wide range of these decisions show that the practical value of the mining laws depends on their present status as established by the courts.

The preparation of these annotations involved an examination of more than 2000 volumes of reports of various courts and public officers. The work is indexed and any desired subject may be readily found. The work on this bulletin has been so expensive that it has been necessary to place the above price on it.

RECENT PUBLICATIONS

FAUNA OF THE SAN PABLO GROUP OF MIDDLE CALIFORNIA. By Bruce L. Clark. Vol. 8, No. 22. P. 188. Charts, 71 plates. University of California, Berkeley, 1915.

RESULTS OF THE INVESTIGATION OF SIX LIGNITE SAMPLES OBTAINED FROM THE PROVINCE OF ALBERTA. By B. F. Haanel and John Blizard. P. 110. Ill., charts, index.

ANNUAL REPORT OF THE MINISTER OF MINES OF BRITISH COLUMBIA FOR 1914, with the report of the Bureau of Mines by the provincial mineralogist, William Fleet Robertson. P. 541. Ill., maps, index. Victoria, 1915. This publication is of great value to all interested in mining in the Dominion.

MOTOR-CYLINDER LUBRICATION. By G. S. Bryan. Reprint from Journal of the American Society of Naval Engineers. P. 14. Illustrated. A study of the conditions under which the lubrication takes place, and of the characteristics of motor-cylinder oils that determine their suitability for these conditions.

U. S. Bureau of Mines, Washington, D. C., 1915:

NOTES ON MINERS' CARBIDE LAMPS. By James W. Paul. *Miners' Circular* 18. P. 10. This is a useful paper, and as acetylene lamps are increasing in use it should be secured by miners and others. An abstract appeared in the PRESS of October 2.

RULES AND REGULATIONS FOR METAL MINES. By W. R. Ingalls, James Douglas, J. R. Finlay, J. Parke Channing, and John Hays Hammond. Bulletin 75. P. 296. Index. The code of mining rules that has been finally drafted by this committee is the co-ordination of the experiences, opinions, and suggestions of a great many men who have assisted the committee in an advisory capacity and as directly employed aids. The former have included many engineers actively engaged in practice, members of professional societies, and members of the bar; the latter have included members of the regular staff of the Bureau of Mines and of the personal staffs of members of the committee. The committee has sought to obtain many points of view and to summarize many experiences. The draft that has been prepared is not offered as the last word upon this subject. There are many phases of this subject with which the committee has been unable to deal thoroughly. The work is thought to be useful under three main heads: (1) as a basis for State legislation; (2) as a basis for private systems of inspection; (3) as a collection of simple rules for the guidance of everybody engaged in mining.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF AUG. 24, 1912,

of MINING and Scientific PRESS, published weekly at San Francisco, California, for October 1, 1915.

Editor—T. A. RICKARD, San Francisco, Cal.
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Sworn to and subscribed before me this 30th day of September, 1915.

[SEAL.] (signed) HENRY B. LISTER,
Notary Public in and for the City and County of San Francisco, State of California. (My commission expires Feb. 1, 1918.)

EDITORIAL

T. A. RICKARD - Editor

PIG-IRON production in the United States during September reached a total of 2,852,561 tons, the highest recorded; the previous best being in February 1913.

THE $500,000,000 loan to the Anglo-French governments should provide at least $50,000,000 for purchase of base metals, more particularly copper and zinc, to be used in the manufacture of munitions.

BUTTE miners are sharing in the profit made by the mining companies, their wages being modified in accordance with the market-price of copper. In August the rate was $3.75 per shift, but in September it was increased to $4. This arrangement is in accord with the Anaconda company's policy of being fair to its employees. It is also a sign of the times.

FORTUNATELY the San Francisco *Chronicle* is not widely read in the Yukon, otherwise the winter gloom of that celebrated mining centre might be deepened by reading of "Dawson City, Alaska" in the columns of a paper published in the midst of the intelligent community by the Golden Gate. Our local contemporaries should study geography. The *Bulletin* lately described the Pyramids as "a range of mountains between France and Spain."

EVERY reader of this paper will find it worth his while to study our Metal Market Review, sent from New York by an independent observer thoroughly in touch with the trade. In his letter this week our correspondent refers to the preference now given to electrolytic copper, as against the old fancy for Lake copper, which used to be considered indispensable for the manufacture of products requiring penetrability. His report on zinc is encouraging to the miner.

ALUMINUM is gaining in popularity owing to the increasing use of it during the War. It is used in the making of a great variety of articles in the soldier's kit, such as canteens, utensils, and conveniences for the pocket. The metal is used increasingly for parts of automobiles and aeroplanes. After the War, those who have become acquainted with aluminum will employ it for other purposes; thus the War is assisting to advertise the metal. France, Great Britain, and Switzerland are important producers, but the United States ranks first. It has been predicted that the world's production in 1915 will be 110,000 tons, which is approximately equal in weight to Michigan's annual output of copper, but more than treble in volume. Aluminum dust is also being employed as a precipitant of the precious metals from cyanide solutions.

RECOGNITION of Carranza will cause Villa to be less careful to placate public sentiment, so that depredations on the mines and smelters of northern Mexico may be attempted during the next few weeks. Already Villa's representative at Chihuahua has ordered the local smelter to reduce the ores confiscated, that is, stolen, from foreign mining properties. But, with the support of our government, the predatory activities of Villa should soon be brought to an end.

MANGANESE has risen in price mainly on account of the cessation of imports from the Caucasus, where are the purest deposits of the ores of this metal. For the making of ferro-manganese an ore not poorer than 42% in manganese and containing not more than 12% silica is required. In California the black oxide is found in the radiolarian chert beds of the Franciscan series, but the deposits are relatively small and they tend to become increasingly silicious as they are followed below the surface. Ferro-manganese is being made on a small scale by electric smelting at Heroult, in Shasta county, where small masses of pure magnetite are available, as well as reasonably cheap power.

OUR excellent contemporary, *The Canadian Mining Journal*, publishes a most useful article on the structural features of the Porcupine ore deposits by Mr. Alfred R. Whitman. His analysis of the conditions modifying the distribution of the gold is of practical service and should be appreciated by those at work in the district. We note with particular interest that Mr. Whitman concludes that no evidence exists, although he has sought for it, to suggest the deformation or bending of the quartz since it was precipitated in the fractures now constituting veins of gold ore. Where subsequent movement has taken place, the quartz is crushed. Such plasticity as may have permitted further compression since the time when the quartz was deposited is to be credited to the schist, which has been deformed unevenly, producing the local variations of structure that Mr. Whitman describes lucidly.

MORENCI and the neighboring mining districts of Clifton and Metcalf are the scenes of a thinly disguised outbreak of anarchy, in which the sinister figure of Moyer looms bigger than that of the Governor of Arizona. We do not know all the rights of the quarrel, the miners may have legitimate grievances, but we sympa-

thize with the managers in their refusal to negotiate with Moyer and his criminal association. The flight of the three managers from their posts of duty to El Paso cannot be imputed to lack of physical courage; we accept the explanation that it was done to remove an incitement to violence that would have involved innocent residents, now terrorized by the Western Federation of Miners. The Governor, as is usual in such cases, is paralyzed by political considerations and is a shuttlecock between the contending factions. The suggestion to refer the matter to the department of Commerce and Labor is a confession of ineptitude, but it may prove the best solution of the difficulty. If that is done, we may hope for an impartial inquiry.

MAGNESITE is one of the many mineral products for which an increased domestic demand has been created by the disturbance in Europe. Before the War the United States was consuming 200,000 tons of this substance, obtaining 120,000 tons from Austria and 60,000 tons from Greece. Until April, shipments of Austrian magnesite were obtained on Italian vessels sailing from Trieste, but the trade has now ceased. Imports from Greece are likewise no longer available as heretofore. Hence the better market for the California product. We may add that the Greek magnesite is used mainly in plastering and fire-proofing, it being too infusible for metallurgical processes, for which purpose the Austrian product is better adapted by reason of an admixture of iron oxide that renders it less refractory and therefore more suitable for fusing into a solid furnace-bed. The ordinary price for dead-burned magnesite as delivered in New York or Chicago is $20 per ton; now the price is $25 in California, making the price of the product about $37 when delivered in the East. On another page Mr. S. H. Dolbear gives some details concerning magnesite mining in California.

UPON another page we publish part of a stirring address delivered by Mr. F. H. Newell at the inaugural meeting of the American Association of Engineers held at Chicago on September 14. True to the Anglo-Celtic tradition, this new departure was formally launched at a dinner, followed by speeches by various representatives of the profession. In consequence, a convention is to be held at Chicago in December. What may be the exact purpose of the new organization is not clear from the information as yet to hand. We note a reference to "the great problem" that is to be solved. Perhaps Mr. Newell will tell our readers what it is. Is it co-operation with a view to fraternal benefit, that is, insurance against ill health or lack of work? The best thing that can be said for the movement is that Mr. Newell apparently is at the head of it. As chief of the Reclamation Service he won a great reputation as a capable and broad-minded executive. We are in sympathy, of course, with the aspirations of the engineering profession and realize that it should exercise a greater influence in the modern community, but we confess to a certain tiredness of associations and societies without definite aim or purpose, serving mainly as an excuse for an occasional banquet at which the oratory and the gastronomy are equally swamped in rich sauces of a deappetizing character. What is the new association going to do for the profession?

Rolls and Ball-Mills v. Stamps

The passing of the stamp-mill has been predicted so often during the last twenty years that one is compelled to discount any new threat to consign that ancient crushing device to the scrap-heap. Various machines have had their day of pride, only to be relegated to the secondary function of re-grinding the product of the stamp-battery. In the treatment of low-grade copper ores of the disseminated chalcocite type there has been a notable development in the use of gyratory crushers followed either by rolls or by ball-mills, without the intervention of stamps. Of all the recent attempts to break away from the old methods, which came to us long ago from Hungary, the most important is that now being made at the big low-grade gold mines of south-eastern Alaska. At intervals we have recorded the progress of the colossal experiment by which the old Perseverance mine, in the hills behind Juneau, has grown out of all recognition into the Gastineau enterprise of the Alaska Gold Mines. In our issue of September 11, Mr. Robert S. Lewis described the main features of the scheme of exploitation, explaining how an ore assaying only $1.50 in gold is treated so that the precious metal is collected with the base-metal sulphides into two kinds of concentrate, one rich in galena, which is shipped to the smelter, and the other predominantly pyritic, which is re-ground previous to being subjected either to cyanidation or amalgamation for the extraction of its gold content. Thus the chief product of the mill is a gold-bearing lead concentrate, which undergoes roasting, at the smelter, before further reduction and disintegration of its valuable contents. The machinery employed to effect this concentration is modeled on the plant used in the treatment of the enormous copper deposit that constitutes the Utah Copper mine. Thus the Gastineau practice is based on the special experience of its promoters and engineers, Mr. D. C. Jackling, the late Albert F. Holden, Messrs. George O. Bradley, and Charles E. Bruff. In this issue we publish a detailed description of a plant of 1000 tons capacity, designed to perform the crushing precedent to such a scheme of concentration. The method seems logical, given the figures of yield and cost that are the first elements of the problem. In the case of these Alaskan mines, as of the famous disseminated copper deposits of Utah, Nevada, and Arizona, the engineer has a magnificent chance to apply his skill, for he is given an abundance of material, which, after all, is the first requisite to the devising of economical schemes of exploitation.

As our readers are aware, the Gastineau mine is next-door to the Juneau, a wide lode of gold-bearing slate traversing both of them. At the Gastineau the practice of the Utah Copper has been adopted in large measure, so that the chief crushing machine is the rolls; at the

Juneau the principal suggestion has been derived from the practice of the Inspiration mine in Arizona, hence ball-mills predominate. Across the strait called the Gastineau Channel, separating the mainland from Douglas island, is the Treadwell group of mines where stamp-milling of the orthodox kind has been applied successfully on a large scale for many years. The obvious contrast between the mills on opposite sides of the water provokes the query as to whether the Treadwell will modify its methods in the light of the later experience afforded by its neighbors. To that question we are able to reply that the management, which is known to be progressive, has not overlooked the opportunity of investigating the new departure in milling. Experiments with various ball-mills and with Deister tables are being made by the manufacturers of these machines, with the cordial approval of the mine managements, both at Treadwell and Juneau. The choice of plant-design is a matter of expediency, regulated in turn by tonnage. At the present time the Treadwell group is equipped for work down to a vertical depth of 3000 feet; if underground explorations justify development to 4500 feet, which will be the next stage, then it will become necessary to consider the erection of a mill adjacent to a central shaft. This means the choice of a consolidated and compact plant, replacing the five different mills, with their aggregate of 960 stamps, now at work, saving a large part of the miscellaneous labor required among the scattered units. The ball-mill gives a maximum crushing capacity at a minimum of space; for example, a mill 8 feet in diameter and only 6 feet long will crush 400 tons per day, and cover a surface about 14 feet square, while a stamp-mill of equal capacity will occupy a space more than twice as large. In both cases two-stage crushing is assumed. At present the ball-mill, as at Juneau, crushes to 40-mesh, in two stages, as against an average of 24-mesh reduction by ordinary stamp-mill practice at Treadwell. This compactness and finer crushing renders the ball-mill attractive, even if it cannot beat the stamp-mill in cheapness, for the old 300-stamp mill at Treadwell has been running during the annual flood-water period at a cost of only 13 cents per ton. Under the ball-mill we include the latest type of Hardinge, in which pebbles are replaced by steel balls; in fact, the ball-mill has developed from the Krupp and Hardinge machines, chiefly by aid of the greater toughness of manganese-steel and the use of subsidiary devices, such as the Dorr classifier. In the Gastineau mill the Garfield table is being used for a 'rougher' or preliminary concentrator, followed by the Wilfley; while the experiments at Treadwell point to one type of Deister table for rough concentration and another type of the same make for fine concentration. The main point is that a mill of 8000 tons daily capacity covers a vast space and involves an enormity of machinery, which means much miscellaneous labor; hence the effort to find machines that are compact and yet of big capacity. All of this effort to obtain maximum capacity on a minimum expenditure of money, while keeping the cost down to the established level, is necessitated in order to compensate for the rising price of labor and the higher expectations of capital. It bespeaks the progressive spirit that animates mining in the West—above all the willingness to dare, in order to learn something new.

The Mexican Government

On October 2 the Secretary of State, with the concurrence of the representatives of the governments of Argentina, Brazil, Chile, Bolivia, Uruguay, and Guatemala, decided to recognize Venustiano Carranza as the head of a *de facto* government in Mexico. In doing so the members of the international conference simply accept the logic of events, for the largest measure of military power in the distracted country south of the Rio Grande undoubtedly rests with the Carranzistas. Villa and his troops have been herded steadily north-westward, while Zapata and his followers have been driven out of Mexico City by the forces of the Constitutionalist party. That party was started in March 1913 when Carranza announced the so-called Plan of Guadalupe, soon after he had fled from Saltillo in fear of Huerta. At that time the First Chief of the Constitutionalists—as Carranza calls himself—was Governor of Coahuila, a state that adjoins Texas. To go back to the commencement of his career, we may note that Carranza began as a lawyer at Saltillo; he was the henchman of Miguel Cardeñas, for 16 years Governor of Coahuila. Cardeñas was a 'scientifico,' that is, an exponent of "scientific business," or, to be plain, systematized graft. Subsequently Carranza became an associate of General Bernardo Reyes, for many years Governor of the adjoining state of Nuevo Leon, at a time when the power of Diaz was declining. Carranza wanted to succeed Cardeñas in the governorship, but Diaz distrusted him, so he was made a senator and called to Mexico City. In the last hours of the old dictator's régime, in 1911, Carranza joined a revolutionary movement started by Reyes. When Diaz was drawn into exile and Madero became president the ambition of Carranza was fulfilled: he became Governor of Coahuila. That was in 1912. Reyes was shot at the beginning of the riot—in February 1913—that ended in the murder of Madero and the rise of Huerta to the presidency. Carranza refused to recognize the latter and fled to Guadalupe, where he published the revolutionary propaganda of the Constitutionalist party, cooperating with Villa until June 1914, when they separated, soon to begin a cat-and-dog fight that has lasted until now. Undoubtedly Villa's natural ability as a commander in the sort of warfare that has persisted in Mexico did much to bring Carranza to the front and the break with his chief lieutenant marks one of the weaknesses of the leader of the Constitutionalist party—his inability to inspire loyalty in his lieutenants. He is an obstinate and pompous man, of mediocre mental equipment, and without military talent. For the success of his later operations he is indebted mainly to Alvaro Obregon, who has been reported repeatedly as about to break with him. Now that Carranza has obtained recognition, and is assured of financial assistance, he will be better

able to hold his principal followers together, so that the military operations will decline in importance, thus throwing into the background his lack of ability in such matters, while giving him a better chance to exhibit his skill as a politician, in which respect he is not deficient. During recent months Carranza has been able to maintain martial rule over the richer part of the country, along the Gulf coast from Vera Cruz to Tampico, and inland to Mexico City itself, which has been repeatedly invaded and evacuated by various so-called armies under the leaders of different factions, until now it is again garrisoned by the Carranzistas. During the desultory guerilla fighting of the last two years the military forces of the revolutionary gangs have been worn down to mere remnants of their original strength, both as regards personnel and equipment. The country at large has been terrorized, ravished, and looted. Carranza and his officers have done their share of atrocities, but they compare favorably with Doroteo Arango Villa (his real name is not Francisco), a butcher's assistant and brigand, who committed his first murder at the age of 14, and Emiliano Zapata, a stable-boy and illiterate bandit, who has been allowed to over-run the southern vicinity of the capital for several years. The recognition of Carranza and his party is an unwilling concession to the logic of events. Carranza comes to office no cleaner than Huerta. The objection made to one applies to the other. Presumably the administration at Washington realizes that no leader can reach the presidential chair of Mexico with white hands. It remained only to make a choice of evils, in order that some semblance of order may be restored. Many of our readers will be inclined to question whether military intervention and the forceful control of the principal railroads would not have been a more effective means of pacification, and we think it likely that this may prove to be the ultimate solution of the problem, but meanwhile the new plan should be given a fair trial. Of course, an embargo will be placed on the export of arms or munitions across the border to those who must now be regarded as insurgents against the lawful government of Mexico, thereby making it increasingly difficult for Villa to maintain organized opposition. The new government will have to be financed so that it may establish itself firmly and also pay indemnities for damage done to foreigners. These financial arrangements are important. We hope that silver coinage will be restored, for that would not only help the mines to resume operations, but would serve as an incentive to peaceful work among the roving bands that have been the curse of industry for three years. The outlook is not without hope. It would be much more cheerful if the educated and professional elements in the population had asserted themselves in patriotic endeavor to restore constitutional government, instead of fleeing from the country and leaving the control of affairs to the illiterate and unruly. One cannot contemplate the recent history of Mexico without asking where are the men of Spanish descent and decent traditions? It is the Indian and the *mestizo* that has been on the rampage so long. They appear to be weary of it, and therein lies the hope that the Carranza government, now that it has won recognition and support, will be able to attract the better elements of the country in an effort to end the chaos of misrule. For that we wish most devoutly; no mining region affords better chances for the intelligent explorer and operator. In wishing better days for the unfortunate Mexican we wish renewed opportunity for the mining engineer.

Bubbles

Those who read the colloquy between the judge and the learned counsel in the flotation suit, as reported in an excerpt from the transcript of record that we publish in this issue, will find relaxation in reading the two following pages, in which our friend, Mr. Ben. S. Revett, tells about his first acquaintance with the bubble process 26 years ago in Oregon. With him it was indeed a bubbly performance, for it began with bubbles of air in an oiled pulp and concluded with carbon di-oxide in a clear liquid, also slightly acid, like Potter's or Delprat's method, but containing more alcohol than is needed in serious metallurgy. The pale amber liquid in which is dissolved the sunshine of the Champagne vineyards has ever been synonymous with the bubbles of pleasure. Man is borne to happiness as the bubbles go upward. If our metallurgists only knew as much about the physics of the bubbles of flotation as they do about the philosophy of the bubbles that enliven the juice of the grape, it would not be necessary for Judge Bradford to catechize Mr. Scott so earnestly. However, what man has done, man can do. The day will come when the flotation bubble will be pricked, as it were, and we shall know its true scientific inwardness. And when that happens, let us hope that the secret will be disclosed simultaneously to so many that the discovery will be described lucidly in the technical press instead of being seen as through a glass darkly in the gazette of the Patent-Office. Indeed, as we tread our mental way through the maze of patented obscurities, whether it be No. 793,808, No. 835,120, or the multitudinous other efforts to state facts without giving information, we find ourselves murmuring that "the earth hath bubbles as the water hath, and these are of them"—bubbles so numerous as to make not only a froth but a thick mist from which is condensed a murky stream of unending litigation. The attempts of patentees to obtain exclusive rights to the use of their fortuitous bubbles reminds us of the picture by Millais in which the boy sits gazing at an iridescent creation of his breath and wonders when it will burst. It is a far cry from the pretty boy to the portly figure of Mr. Criley at Baker City, but they are joined in the pursuit of the elusive film that catches the rainbow hues of hope. Mr. Criley's bubbles went flat long ago, but we are glad to think that those of his observer, who learned early to respect another man's hobby, are still rising cheerfully in the glass of time. We hope that they may prove to be so numerous and persistent as to compose a froth on which rich minerals may be conveyed to a safe haven of effective concentration.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Meetings and Discussions

The Editor:

Sir—Your editorial in the PRESS of October 2 seems to take a jaundiced view of the meetings of the International Engineering Congress. Were the banquets too much for you? You may be right as regards the meetings or meeting (I think there was but one?), of the mining section, where, as you point out in your editorial, most of the time was taken up in reading from manuscript long and dull papers, or in reading equally long and dull abstracts, and where the discussion was confined to a dispute as regards facts, impossible to ascertain except by an independent investigation that might easily cost some tens of thousands of dollars. There was another short discussion in which an algebraic error was discovered.

But whatever may have been the sad results of the meetings of the mining section, I wish to protest against your insinuation that the metallurgical sessions were not all that they should have been. Perhaps it is too strong a statement to say that these metallurgical sessions were ideal, but they were, at the very least, useful and informing—and not dull. The reason that these meetings were so good is that they were run on exactly the lines indicated in your editorial. The inexperienced chairman was avoided and in his place such parliamentary experts as Messrs. Butters, Clevenger, and Ricketts were selected. Next, preparation for the discussion of the papers was made by inviting engineers familiar with the subject to attend the meetings; they did attend and as a result the ensuing discussions were lively, and instructive. Perhaps the best discussion was on Laist's paper on 'Advances in Copper Smelting.' Indeed, under the exhilarating influence of good fellowship, and in exchange for valuable information, some unexpected disclosures of trade secrets were made by managers of large works. I heard several auditors remark that they never would have learned certain details had they not come out in discussion. Not that any harm was caused by these disclosures—far from it. All that happened was that the gates of secrecy were raised for a moment and a slight quantity of exclusive information was allowed to flow freely.

The error of wearying the audience by long abstracts or the reading of long papers was kept well in hand by chairmen and secretaries, who frequently saved valuable time by gentle hints to the speakers. Since much preparatory work was done to make these metallurgical meetings a success, and as all who attended seemed to think the meeting successful, I feel that your statements as to the inefficiency of the meetings ought not to go unchallenged and I wish to state that whatever may have been the character of the meetings of the mining section those of the metallurgical section were eminently successful and practically free from the faults that you have rightly condemned in your editorial.

JOHN WILLIAMS.

Denver, October 4.

Refusal to Meet Miners

The Editor:

Sir—The general managers of the Arizona Copper, the Detroit Copper, and the Shannon Copper companies were arrested at Lordsburg, New Mexico, on October 2, on the charge of inciting a riot by refusing to negotiate with the officers of the Western Federation of Miners, and by leaving their mines at Clifton, Arizona, where several thousand miners are on a strike. Their action is held by the Arizona authorities to tend toward disorder and is deemed a felony under the laws of that State. After a hearing before the justice of peace at Lordsburg, the managers were released.

I have no desire to criticize the flight of the managers. It is, indeed, quite probable that they left the mines under positive orders from headquarters. Moreover, they knew all the conditions; their departure may have been prudent and commendable. Nor do I in any way wish to countenance any violence on the part of the strikers, or to support the Western Federation of Miners. I wish, however, to state clearly that I think, as a rule, mining operators make a great mistake when they refuse to meet the representatives of the miners. It may be that in this Clifton case such refusal may have been a mark of highest wisdom, but I doubt it. There is probably no method of irritation that is more effective in driving men to desperation than a refusal to listen to their complaints or to meet their representatives. Such refusal practically says to the miners that they are too insignificant or too vile to deal with, or else that the management has fully made up its mind and is deaf to argument. In fact, the refusal is nothing but a goad to stir men to desperate acts. So it has stirred men in the past, and so it will stir them in the future. It is stated on excellent authority that most, if not all, of the atrocities of the last Colorado strike might have been avoided had the operators consented to meet the miners.

In most cases of a refusal to meet the men it is argued by the management that such meeting will be in fact a

recognition of the Union and will serve no good end. I recently heard a manager who has long been in charge of a large corporation state that the men know what they want and the managers know what they are prepared to grant; so what is the use of a conference? This argument, if carried to its logical limits, would put a stop to most of the world's business, for what does most business consist of but conferences between men who wish to find a common meeting-ground? It is certainly not true to say that bodies of men that have once made up their minds may not afterward change them. A good instance to the contrary was the settlement of the anthracite strike in 1902; there was a deadlock, and the 147,000 miners on one side and the anthracite operators on the other could find no adjustment of their differences. However, the Commission appointed by President Roosevelt was able to find a method of operating the mines that has worked for thirteen years without the recurrence of strikes. I do not suggest that meetings between the operators and the miners are going to abolish strikes, but I do feel that it is a method that works for peace, and in these days of desperate strikes, where armed forces battle for days, it is the part of wisdom to try all the conciliatory measures possible. For my part, rather than refuse to meet the miners I would advocate inviting them to dinner and discussing difficulties over coffee and cigars instead of over machine-guns and bombs. Let us have peace.

HAROLD JAMESON.

Oakland, October 5.

The Prospector

The Editor:

Sir—Under the above heading in your issue of September 18, I read a communication in which your correspondent complains that too much caution is used by examining engineers when reporting on prospects. As one who has spent many years both as a prospector and an investigating engineer, may I offer some remarks on the subject.

I fear that your correspondent sees the subject entirely from the view-point of a prospector, and that he has not been placed in a position where he is responsible to an investor who places entire confidence in him by accepting his judgment, and by spending a large sum of money in following out his recommendations.

My own experience, extending over many years, has led me into the mining regions as a prospector, and often while seated around the camp-fire, I have joined in strong language at the shortsightedness of the investigating engineer who turned down our prospects, regardless of their worth, and indifferent to the apparent merits of the discovery. This is how it seemed to us at any rate.

But looking at the subject from the view-point of the investor, who risks his money in the new venture, can an engineer be too cautious? I think not, even though some of the greatest copper-producing mines of the present time were in earlier days turned down under expert advice.

It has always been my belief that the ability of an engineer to pass accurately on the value of a prospect requires just the same amount of skill and sound judgment, just as wide experience, and the use of as much caution as is demanded in the examination of a developed mine, if not more so, for he has not the developments of the mine to assist and guide him in forming an opinion as to the future possibilities of the discovery, and he must therefore decide from his experience in similar cases whether or no the prospect should be taken up or turned down. Every time he makes a mistake his employer loses money, and his own reputation suffers; therefore, caution, extreme caution should be his watchword, otherwise he may rest assured that, sooner or later, the employer will be broke, and the engineer discredited.

How many prospects develop into mines There are no statistics with which to answer the question, but everyone who has been connected with mining for any length of time knows that the percentage is very small, certainly not 1%, probably not even half of 1 per cent.

It should not be difficult therefore for your correspondent to appreciate why so much caution is used in the investigation of mines and prospects; it is not because the prospector is regarded as a faker—for he is not—but because good sound judgment demands caution in a business that contains risks no amount of foresight can wholly remove.

ERNEST G. LOCKE.

Rochester, Nevada, October 1.

The Editor:

Sir—I am particularly struck with the communication in your last issue from Mr. Richardson, and your comment thereon. There is no question but what the decadence of the prospector is largely due to his inability to 'place' a good prospect—when he finds one—to the fact that he must come up against the mining engineer, who will inform him, with lordly disdain for the prospector's humble opinion, that he must "do more development" on his claim before he can expect the syndicate, which this engineer claims to represent, to pay any money for the really intelligent selection that the prospector has made of ground still open in Uncle Sam's domain of mineral land, to say nothing of the hard licks he has put in for three, five, or ten years—in doing the necessary assessment work.

I have a consistent regard for, and sympathy with, the prospector and am pleased to learn that you are willing to "stand somewhere between him and the amateur," for it is my fixed opinion that there would not be so much of a wail throughout our mining territory in the U. S. over the "passing of the prospector" were it not for the frequently unfair attitude of capital (and I regret to say of my brother engineers also) toward the struggling man with the pick and shovel who makes discovery of mines, for the late comer to profit by at the rate of 100% to 1000% on his investment.

This does not mean that the prospector always has a true valuation of what he has discovered, for many of

them should be carrying a hod instead of mining, but it is certainly a fact beyond dispute that many of the men with whom you and I have "shared blankets and bacon" deserve far more than they have received.

I failed to participate in the discussion, some months ago, which ran through several issues of the PRESS and which elicited valuable opinions as to reasons for fewer and fewer men engaging in the business of prospecting, but I venture the assertion that mining, and particularly exploitation of new territory, is suffering because of the reward to the prospector not being commensurate with the effort put forth.

F. L. SIZER.

San Francisco, October 4.

Classification and Fine Grinding

The Editor:

Sir—Metallurgists now fully realize the importance of classification prior to the fine grinding of ore. In order to obtain the maximum efficiency from tube-mills, it is necessary practically to eliminate all slime from the feed.

There are mechanical classifiers now in use that will separate (−200 mesh) slime from sand very efficiently, such as the Dorr, Esperanza, Akins, and Ovoca. Beyond this point, if one desires to separate a −100 or −60 product from the tube-mill feed, it is not efficiently done by the above machines. In fact, their makers do not claim to do so.

I believe in the short tube-mill, in sizes of 6 by 6, 8 by 8, and 10 by 10 ft. These are particularly suitable for gravity-concentration mills (intermediate grinding) in which the minimum production of slime is desired. No doubt, in many gold-milling plants where 'all-sliming' is not necessary, they would be far more economical than the 5 by 20-ft. tube-mill.

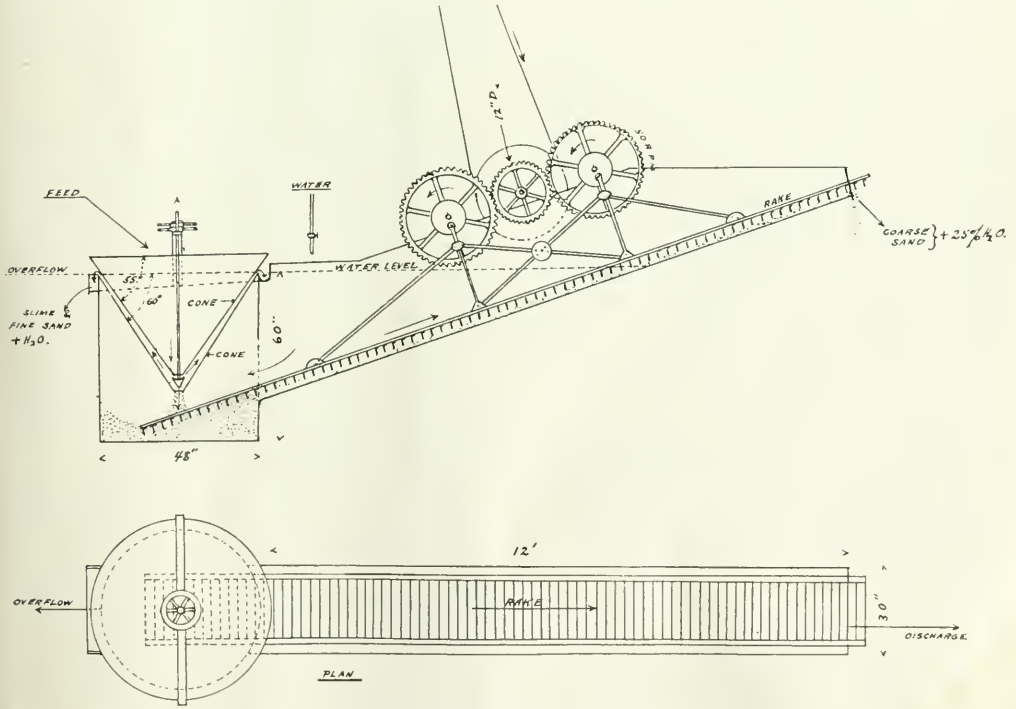
Oil-flotation and tin-dressing plants will find short tubes more economical and efficient than Chilean mills, long tubes, or pans for intermediate grinding.

However, a certain type of mechanical classifier is necessary for the short tube-mill that will separate a −60 or a −80 product from the feed in order to get the maximum duty or grinding result. A classifier that combines the results of the spitzlutten and mechanical screw or rake-classifier will produce the desired product. With such a machine one could deliver to the tube just that product plus 40% moisture that would pay to re-grind. Such a classifier would meet the requirements better than any one of the machines on the market at the present time.

I therefore offer for the consideration of mill-men the type of classifier shown in the inclosed drawing.

A. E. DRUCKER.

London, August 25.



A COMBINED HYDRAULIC AND RAKE CLASSIFIER. CAPACITY 200 TO 250 TONS PER 24 HOURS.

The Engineer Awakes

By F. H. NEWELL

*Now is the day of awakening of the engineer as a man and as a citizen to a larger realization of his duty to society in general, to his profession, and to himself in particular. He is not alone in this. The world-wide war has shocked into life many dormant conceptions and has opened the eyes of mankind to the larger claims of brotherhood. The horrors of the destruction of life and property and the ruthlessness with which the accumulations of centuries and the hopes of the future have been sacrificed is bringing about a reaction and is preparing the way for the growth of a larger human consciousness. The engineers in this peaceful country are not unaffected. Their occupation in a large part has been reduced and as a result they have been afforded time and need for thinking on these vital matters. They are getting fully awake to their part in the world's progress.

There is nothing really new in this awakening, except perhaps in the greater intensity and vigor of the accumulated forces at work. Life with its rhythmic character is a constant series of awakenings; we remain quiescent or sleep until hunger sharpens the appetite and forces a clearer realization of surrounding conditions. This is literally true at the present time. The hunger or threatened hunger of large numbers of professional men is causing them to note more keenly their surroundings and their relations to each other and to the public.

More than this the present century is that of organization. The zeal for the study of efficiency, the demand for larger and more effective organizations, the value of preparedness, all of these are being forced on the attention of the thinking man; he is seeing as never before the need of organization and of sacrificing some of his individuality in the interest of work for and with his neighbor.

What distinguishes an engineer? It is a word in common use, but few of us can agree upon a definition. We ride on the railroad train; everyone knows whom we mean when we speak about the engineer of the train, and yet in the present talk we do not consider this man as necessarily belonging to the engineering profession. Our lives depend largely upon his faithfulness to duty, his intelligence and his skill; no man ranks higher in public confidence than the locomotive engineers who are safely carrying each day millions of passengers. In our present discussion, however, we have in mind not the engineer who operates an engine, nor the mechanic however skilled he may be, but rather the man, who may be a mechanic or engine-runner, but who is essentially something more. What is that quality which we are endeavoring to include in the term 'engineer'?

The quality which distinguishes the engineer as a professional man from his brother the mechanic is education. The engineer is undoubtedly benefited if at the same time he is a good mechanic, although he may be a success even if he has little or no mechanical ability. To be an engineer in the true sense, he must have, however, that education which enables him to understand the true perspective of things, to know the big from the little, to obtain facts and judge correctly from these.

Why should he serve? The education of the engineer, whether obtained through books or through things, has been largely at the expense of some other person—either society, the state, or his more immediate employers. If he is a graduate of a university or an engineering school, the cost of his education, in part at least, has been borne by the philanthropically endowed college or by taxes levied directly or indirectly for the support of a state institution. If he is not a college graduate his early education has been more largely at the expense of his parents and to a less degree at that of his employer. It is assumed usually that in the case of an employer he has returned value received, but most of the older engineers will testify that they have usually made large investments in educating young and untrained men from whom they have not always received a full return. However this may be, it is safe to say that the majority of engineers are indebted to some one for the opportunities which they enjoy; as a body they owe a duty to the state and to society as well as to their profession.

It is this recognition of duty which gives rise to the ethics of the engineering profession and which distinguishes the engineer as a professional man from the ordinary mechanic, who from lack of this education does not feel bound to the same degree by written or unwritten codes. These ethics are well recognized, although like many other matters of common knowledge they are often difficult of exact definition. We know when they have been violated and yet may debate long as to the exact line between ethical and unethical conduct. The conception of engineering ethics is fundamental to the profession, and finds its highest expression in service.

Service to the public and to the engineering profession by means of service to the members should be the motto of any organization of engineers.

What is this service which all should be eager to render and which is the fruition of years of training? What do we mean when we claim that the highest function of the engineer and his greatest reward is found in effective service? The word conveys the idea of help rendered to another, not as a favor involving an obligation, nor on the other hand as a matter of self-sacrifice. It is something which may be expected though it cannot be demanded, and may be performed among equals. Service consists of those acts which tend to lessen trouble or increase the health, prosperity, and convenience of others.

Engineers in performing service are by this very fact entitled to full recognition. Service implies a suitable reward, and while the effort may be altruistic, it does not involve unnecessary self-denial. A proper remuneration, one assuring a good living, is due to the engineer. He who performs service rightfully does it with full expectation of reward, directly or indirectly in the satisfaction of duty well done.

*Abstract of an address before the American Association of Engineers, September 14, 1915.

Air-Froth Flotation

A LEGAL VERSION OF THE TECHNOLOGY OF THE PROCESS

[Herewith we give a part of the address made by Mr. Walter A. Scott, counsel for defendants in the case of Minerals Separation *v.* Miami recently tried at Wilmington, Delaware. We give this not only because the learned gentleman discusses the underlying principles of the flotation process in an interesting way but because the questions put by the Judge are such as would suggest themselves to other persons curious to understand the subject. In reading this excerpt from the court proceedings our readers must not forget that it is an *ex parte* statement, putting forth the technology of the subject with a view to aiding the case for the defendant. Mr. Scott assumes that oil is necessary to flotation and also that the force of surface tension bursts the bubbles. Neither of these assumptions can be taken for granted in a scientific discussion, however useful they may be in a lawyer's brief. The perforated-coil machine to which he refers is shown on page 587 of this issue.—EDITOR.]

The manifestation of the force of surface tension is a phenomenon that shows itself as a tendency of any liquid body—we may confine ourselves to a liquid—to assume that shape in which it has the least surface. It is a well-known fact that in the form of a sphere the ratio of surface to volume is at the minimum. Therefore we can say that surface tension is that force or property which tends to cause a body of liquid to assume the spherical form, in order to make its surrounding surface as small as possible.

We are familiar with manifestations of this force: when a drop of water falls upon a hot stove, we see it immediately come into the form of a little sphere. The explanation of that probably is that the stove, being hot, generates a little steam all around the particles, and that frees it from interference by other forces, so that it assumes the shape which surface tension tends to give it.

I think the ordinary shot-tower, where molten lead when poured or dropped assumes the spherical form of shot is probably another manifestation of surface tension. The lead, instead of dropping in a formless mass as it passes through the air, under the influence of the contractile force around its surface is drawn up into a spherical body.

Another illustration is the tendency which we observe when water is spilled, we will say, upon a smooth surface or table. Were it not for surface tension it would spread out in an infinitely thin layer; gravity would tend to pull it down flat. But surface tension causes it to assume the form of a little bulge of water on the table. The viscosity of the water probably also plays a part in that. It is difficult to disentangle all of these causes. But surface tension surely is one of the forces to enter into that effect.

Now, this surface tension exists not only at the free air-surface (for instance, the surface of the water in this glass) but it exists at every point where there is a change of medium, that is, where the water encounters another substance. Surface tension here is along the water surface, the air surface, but that surface tension exists clear around the inner surface of the glass and at the bottom of the glass; it has the same relation to the water around the glass and at the bottom of the glass as next the atmosphere above. So this surface tension exerts itself about the entire surface of a body of liquid, tending to draw it into a spherical form.

As we observe a bubble—for instance, a soap-bubble—the idea that we are apt to have is that the bubble bursts from an interior force; that is, that it explodes. We are accustomed to that thought in connection with any explosion or bursting. I apprehend from the testimony of these experts that a lessening of this contractile force, or the surface tension, tends to permanency of a froth; from that fact I apprehend that the force causing a bubble to burst is not an expansive force from the inside, but that it is due to surface tension, if the surface tension is strong enough. For instance, imagine a soap-bubble, we will say, three inches in diameter. It is surrounded by a very thin film of water contaminated or modified by soap. The amount of water in that film which surrounds the air inside of the bubble is, as we may well imagine, very small. The ordinary soap bubble bursting upon this piece of paper would hardly leave a visible sign of water. Now, as that bubble exists as a bubble the surface of that very small amount of water is very large. It is the entire outer surface of that bubble, and the entire inner surface, where the film comes in contact with the exterior air, and where it comes in contact on the inside with the enclosed air. Now, over that immense surface, for it is truly immense in consideration of the small amount of water, there is this contractile force, as if around the bubble there were stretched a sheet of rubber constantly drawing inward to make that bubble smaller, and the effort of that force of surface tension to reduce the area of the water forming the film of the bubble, simply pulls it in, bursts it, reduces it to a drop, which has the minimum of surface. So I apprehend that the reason the bubbles in these froths burst is on account of that shrinking inward, that tendency of surface tension to gather the water into the smallest possible compass.

The experts who have testified in this case say (and their views are in harmony with the literature on the subject) that any substance which tends to lower or lessen the surface tension of water tends to make the bubbles or the froth more persistent or permanent: and in view of what I have said, I think the reason why these modifying agents which lower the surface tension of

water also tend to make the froth more permanent is clear. In the case of pure water, having a surface tension which I think is—well, it is arbitrarily represented by some numeral—we can say 1. It makes no difference. Now, that force of surface tension in clear water is strong enough to burst these bubbles. It pulls in and bursts them. But if the water is modified by some agent, such as an oil in emulsion, or a soluble substance, such as phenol or cresol, that contractile drawing-in force is lessened, and therefore the bubble has greater longevity, can exist longer, because there is not this constant pulling in. So, while this surface tension manifests itself in various ways and has been utilized in various ways, so far as this bubble flotation or froth flotation is concerned, I think it is clear why a lowering of that surface tension tends to permit a bubble to exist longer. And all of the experts in this case are in perfect agreement that an insoluble oil mixed up, or emulsified, lowers the surface tension in precisely the same way that a dissolved substance does.

The phenomenon of the flotation of small particles upon the surface of water, as upon the surface of water in that glass, has been referred to as surface tension flotation or skin flotation. That is a matter of arbitrary nomenclature. The surface tension effect does not enter into that effect any more than it does in bubble flotation. This stretched membrane, as we picture it, surrounding a body of liquid and tending to draw it into a small compass, also has the property of supporting a small particle upon the upper surface of a body of water, but the name 'surface tension' should not properly be restricted to that kind of a flotation, because the surface tension phenomena enter into all flotations, and it is the lowering of that surface tension that leads to the formation of these froths which have more or less permanency.

* * * * * * * * * *

Besides these various prior art patents and publications that I have referred to, in which the lowering of surface tension is utilized for the purpose of giving permanency to a froth or a bubble, we have other patents, I believe owned by the complainants in this case, patents issued to scientific men, technical men, the officials connected with these companies, in which they also explain the use of both soluble and insoluble reagents for the purpose of contributing efficiency to a bubble or froth process.

Notable among those is patent 788,247, which is in evidence.

Patent 788,247 was granted to Cattermole, Sulman, and Picard. Sulman and Picard are two of the grantees of the patent in suit. Now, in this process—

The Court (interposing): What is the date of that patent?

Mr. Scott: The date of the grant was April 25, 1905; the date of the application was March 29, 1904. In their statement of invention in patent 788,247 they say:

"Our process has for its object the separation of minerals from silicious or earthy matters of ores by means of soaps or similar compounds and is dependent upon the superior physical attraction exhibited by minerals for fatty or resin acids, or for certain other aromatic derivates, such as phenols, cresols, etc., which form soluble salts or compounds with alkaline hydrates."

Then upon the first page of that same patent they state:

"The mineral particles now attached to or more or less coated or enclosed by films of fatty or resin acids and the like, are capable of being separated from the gangue or earthy particles by various methods, depending upon this altered physical condition. For example, the coated mineral particles may be removed by generating gaseous bubbles in the mixture, which preferentially attach themselves to the fatty or similar acid coated particles and raise them to the surface of the pulp, whence they may be removed by skimming or the like."

There is a clear statement of the use of soluble agents, the very soluble agents which are mentioned in the patents here in suit, with their use in connection with gases for raising them to the surface, and the only way in which a gas can function is as a bubble, and this effect of lowering the surface tension was there brought about by the same substances which are in use today.

In patent 793,808, which is the patent disclosing the perforated spiral coil that we have had so much discussion about, the patentees state:

"The present invention relates to the concentration of ores by separation of the metalliferous constituents and graphite, carbon, sulphur and the like, from the gangue, by means of oils, grease, tar, or any similar substance which has a preferential affinity for metalliferous matter over gangue."

The tar there mentioned is one of the substances in use today. Coal-tar is the principal source, I think, of phenol and cresol, and it is used in a crude state in flotation operations. I think it is one of the substances which the answers to the interrogatories say has been used by the Miami company. It is partially soluble and partially insoluble. It is a mixture. And then this patent, after naming these substances, oil, grease, insoluble substances, and then mentioning in the same breath tar, which is partially soluble and partially insoluble, the same as is the frothing agent used at Miami, after explaining the use of these substances goes on to say:

"According to one method of carrying out our invention suitably crushed ore is suspended in water. To this suspension a proportion of oil, grease, or tar (hereinafter referred to as 'oil') is added and duly mixed with the mass by any suitable means in quantity insufficient to raise the oiled mineral by virtue of the flotation power of the oil alone. A suitable gas is now generated in or introduced into the mixture, such as air, carbonic acid gas, sulphurated hydrogen, or the like."

Now here again we have a process in which a soluble agent is used. Tar is not completely soluble, but the complainant has taken the position, which I will accept for the purpose of argument at present, that if any constituent of a substance is soluble, then the substance is a soluble agent under the second and third patents in suit. Accepting, for the sake of argument, this construction of

these patents, we have here disclosed, down to the minutest detail, every operation that is performed at Miami. We have tar, a mixture of soluble and insoluble agents; we have the admixture of that substance with the pulp; we have the introduction of that substance into a vessel provided at the bottom with means for the admission of air; that means being this perforated spiral coil.

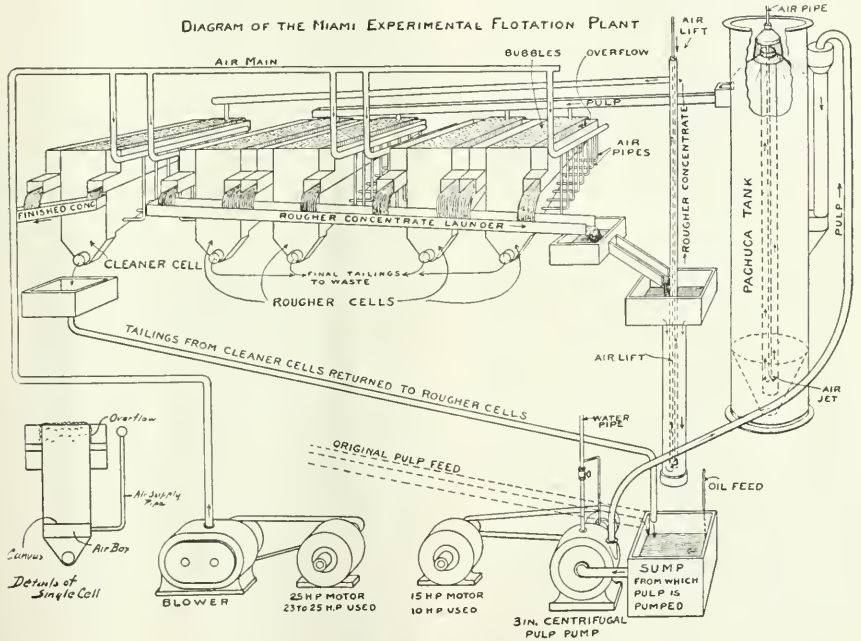
2 p.m. Same day.

Mr. Scott: If the Court please, just before the recess I was speaking of the spiral coil-pipe machine, the perforated spiral, and had stated that this process was identical with the operations at Miami. In fact, I think it will be difficult for anyone to conceive of any different action on the part of air bubbles escaping through fine holes in a metal pipe or a sheet of metal, and the same bubbles escaping through similar holes in a canvas bottom. I do not think the thing needs any argument, the two processes are absolutely identical.

An attempt has been made to establish the appearance of identity between that fragile mass of bubbles which results from the Miami operation, and from the patent 793,808 and the persistent froth that results from the violent agitation of the patents in suit.

Now certainly to the eye there is no identity whatever. And going further, looking to the real essence of the two operations, we find as great a distinction as there is in the appearance. The agitation froth results from violent agitation of the pulp, beating the air into very fine particles and then bringing the liquid to rest; as the Court has seen here in court, when the agitating mechanism was stopped, there arises this persistent froth which lasts for days. Even when shaken in a bottle in accordance with the directions of the California Technical Journal*, we showed the Court a froth that had stood for some two weeks, I think Mr. Dosenbach testified. That froth was so strong that it remained as a bridge across the bottle, even after the water had evaporated out from beneath it I think that matter was called to the attention of the Court, that the stopper had been left out, and that froth was so strong that it simply adhered to the sides of the bottle, and bridged across the bottle without any support whatever from below. That is characteristic of all these froths that are formed by this violent agitation.

Now contrasting with that we have what was exhibited



AN ILLUSTRATION USED IN THE BUTTE & SUPERIOR CASE.

to the Court in many experiments with the canvas-bottom machine, our Exhibit 53, and in the perforated spiral-pipe machine, our Exhibit 52.

The first difference that strikes one is that in this agitation process the liquid must be brought to rest before the froth will form. The froth will not form in the presence of and simultaneously with that violent agitation. The agitating mechanism either must be stopped, or the liquid must be conducted into a side vessel where it will be quiet. As it was exhibited in court, the agitating mechanism was stopped, that being merely for convenience in demonstration. Both complainant and defendant did it in that manner. Of course, that would

*[*The California Journal of Technology.* Mr. Scott is referring to the article by the three students abstracted in our issue of July 31, 1915.—Editor.]

make the operation intermittent if it was applied in practice. It would simply be agitated, and stop, and take off some froth, and then take more material, and agitate again. As I think the Court is informed, in practice the pulp flows in a continuous stream through these agitating vessels and then into quiet vessels where there is no agitator, vessels called 'spitzkasten,' and the current as it flows along is so slow and gentle that the froth rises in these quiet spitzkasten after having been previously agitated in the adjoining agitation vessel. And that is a *sine qua non* of this agitation process: that the pulp be subjected first to violent agitation and then be brought to rest for this coherent froth to rise.

Now, it is equally of the essence and vital to the process carried on at Miami that just the opposite conditions prevail. In the process as carried on at Miami the bubbles which carry the metal concentrate to the surface can rise and can exist only in the presence of these incoming streams of air from the bottom of the vessel. The complainant has contended that the mere gentle entrance of these bubbles at the bottom of the vessel is the equivalent of the violent agitation which forms a vital and essential element in the processes of the patents in suit.

There again to the eye there is no similarity and no equivalency. In the agitation-froth process of the patents in suit—and they are all alike in the mechanical treatment of the pulp by agitation—we have a mass of water that is beaten into a perfect vortex or maelstrom, as violent a movement as we can conceive of; whereas in the Miami process where the air is admitted through a permeable bottom, we have no more agitation than one would observe in a glass of charged liquor, soda water or champagne. There are simply the rising bubbles coming through the liquid. So far there is no similarity.

Look at the principle of the thing. There is an even greater dissimilarity. In the first place, as I have just stated, in the agitation-froth process the froth or bubbles can rise only after the agitation has stopped, or after the pulp has been conducted to a quiet place away from the agitating vessel.

In the Miami process the moment the influx of air stops—and air is what is contended to be the equivalent of the agitation, that is, the incoming stream of air—the minute that stops in the Miami process, the entire body of bubbles carrying the concentrate collapses, and I think your Honor has a vivid impression of that demonstration in which Mr. Yerxa and Mr. Hunt first turned on the air in that spiral-coil machine, and in the canvas-bottom machine, and built up this mass of bubbles, and then suddenly turned the air off, whereupon this all dropped.

Now, looking at the matter of equivalency, it seems to be an impossible construction of the facts and law to urge that the incoming air-streams in the bottom of the permeable-bottom cell, whether it be the spiral pipe or the canvas bottom, is the equivalent of the agitation, when their action is precisely opposite in respect to the formation of the froth. In one case the froth forms only when the agitation ceases. In the other the floating or rising bubbles exist only while the so-called agitation is going on. The principle of the two things is as different as the manifestation of that principle. The manifestation differs in this respect that I have pointed out. In one the froth rises when the agitation stops. In the other the bubbles can rise only when this so-called agitation is going on.

Now as to the principle. The two processes attack the problem in completely different ways. In the agitation-froth process the thought is so to treat this pulp by violent agitation that a froth will form and exist after agitation, that froth to be of so permanent and lasting a character that it can be manipulated, can be floated or skimmed off, as the Court has seen witnesses do in this case. The idea there, was by this agitation to effect a separation more or less permanent between the gangue and the concentrate, to get the gangue at the bottom and the concentrate at the top—to stratify them, as it were. We have the two strata with an intervening stratum of water. And then to take off that froth in any way which may be convenient, either by simply flowing off or by skimming, as has been explained by complainants' witnesses in that instance where they had a revolving paddle something after the fashion of the stern-wheel on some of the river-steamers. That paddle would revolve and scrape off this froth.

In the Miami process the mode of attack upon the problem is completely different. There is no idea in the Miami process of stratifying these materials and making a permanent float, which can be scraped off or floated off. The thought there, and the process as actually carried out, is to admit at the bottom of the vessel containing the pulp with the agent that is used, a stream of air bubbles which act, as Dr. Liebmann has said, simply like an updraft. These air bubbles, rising by the force of gravity through the water, collect the mineral particles by reason of the fact that they do collect them. That is about all that we can say, that the mineral particles adhere to these bubbles while the gangue does not.

Then the bubbles come to the surface of the water and break almost instantly. There is a constant succession of breaking bubbles, but the influx of air at the bottom of this vessel manufactures these bubbles at a slightly more rapid rate than they break, and for that reason the upper layer of bubbles is overflowed from the top of the vessel and saved, with their burden of mineral. The only reason that the Miami process is a success, or that the process of patent 793,808 is a success, is that it is possible by these rising bubbles to make the bubbles a little faster than they break. If they broke as fast as they were made, we would never have any appreciable amount of bubbles on top. They would simply break, each one in time for the next one to come up; but as it is there is a small interval of time before they break, and more bubbles are being formed at a rate so rapid that some of those bubbles are raised to the top and carried over the top before they have broken, and that is the only reason that it is possible to concentrate ores in that way.

The frothing process, on the other hand, is not depend-

ent upon any such principle at all. The thing is simply agitated violently, and when the agitation stops, this froth rises and floats much the same as a board would. It may not be as long-lived as a piece of wood, but it lasts for weeks, and it simply rises there and floats. Speaking with regard to the purpose of concentration, it is permanent, within the limitations that permaneney is necessary or desirable.

Now in view—

THE COURT: Let me see if I get your idea. Do you draw a distinction between a process which results in the formation of what is termed a permanent froth, and a process in which the bubbles come up in rapid succession, but not in such quantities or in such close proximity as to form a permanent froth, but as soon as they get to the surface they float away; is that what you mean?

MR. SCOTT: They float over, if we get them over before they break. It is a kind of a race.

THE COURT: If you get them over before they break? But suppose they break before you get them over, what becomes of the mineral?

MR. SCOTT: Then, as is shown in these demonstrations, if they do break, the mineral drops, and it is caught by the bubbles below.

THE COURT: And brought up again?

MR. SCOTT: And brought up again. The bubbles must be brought up fast enough so that it will gradually be raised.

THE COURT: That is, above the surface?

MR. SCOTT: Yes. There must be new bubbles coming fast enough so that it is gradually carried up over.

THE COURT: And they float off?

MR. SCOTT: And finally float off.

THE COURT: That is what I meant. I did not express it in that way. You expressed it in two stages, a first mass of bubbles and a succeeding mass of bubbles, but that was what was in my mind.

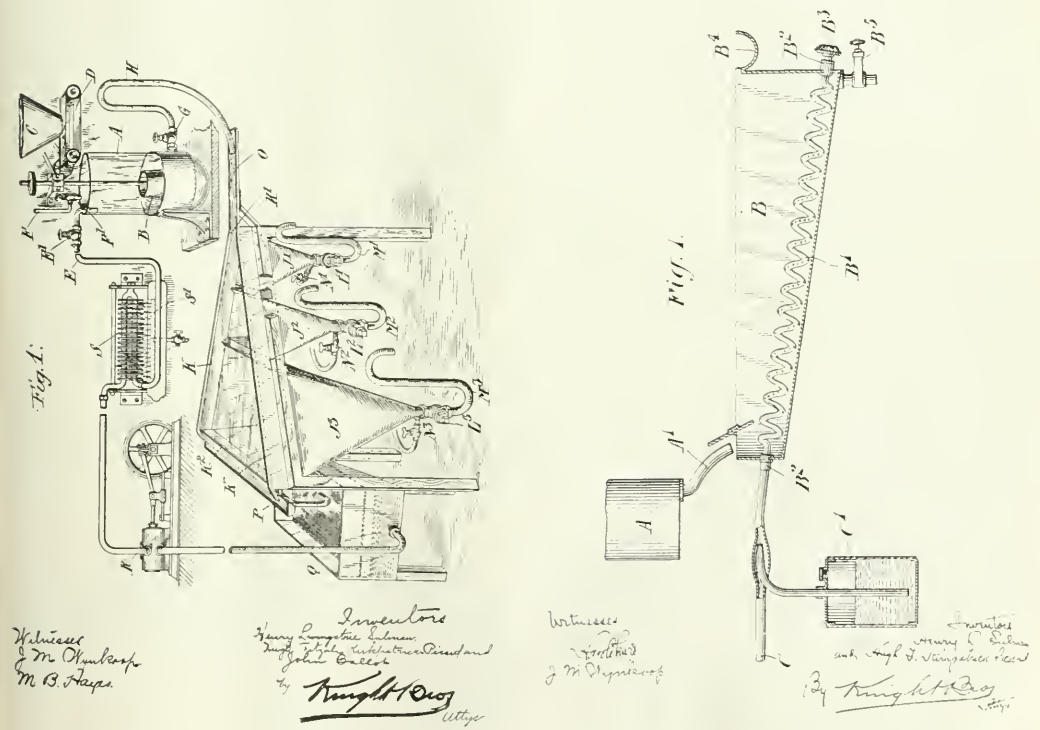
MR. SCOTT: The same idea, I think.

THE COURT: That there is no permanence?

MR. SCOTT: No permanence in the bubbles process at Miami. Now, if the Court remembers the mass of bubbles was probably about 6 inches high above the water, as I remember it.

MR. KENYON: Ten or twelve inches high.

MR. SCOTT: Ten or twelve inches high. It was quite high. Now, if a particle should be allowed to drop by



REDUCED FACSIMILES OF DRAWINGS ACCOMPANYING TWO IMPORTANT PATENTS.

reason of the bubble breaking, it would be caught on a bubble below, and thus constantly raised up by new bubbles coming into the bottom, so that it is, as you might say, a case of stepping back an inch and going forward two inches, and gradually getting over, despite the breaking of the bubbles.

The term 'flotation' seems inaccurate as applied to this Miami process. In the agitation-froth process, after the agitation is stopped, this froth actually does float. It will float for hours, and days, and weeks, and stay on the top of the water; but in the Miami process, as soon as the incoming current of air stops, everything drops, and we have the clear water-surface on the top of the cell. Now, that demonstrates absolutely that that mass of bubbles several inches deep, which we see in the Miami process operation, or that of the patent 793,808, is not really floating. It is held up there by the current of air, which holds it in place. That current of air not only manufactures these bubbles so fast that we have that mass of bubbles there, but it actually holds them up in position, and the minute the air is turned off everything drops. The mineral goes right to the bottom, and the bubbles break. So that instead of a floating mass of concentrate, it seems to me that it is best described, as I think I did once before in opening the case, by saying that this Miami operation is similar to these devices we have seen, where a stream of air is blown out of a pipe and a ball floats above it. The minute the stream of air is turned off the ball drops. In popular language, we may say that that ball is floating in the air, but obviously that is a misnomer, if we attach any exact meaning to our words.

Now, the Miami process is analogous to this ball held up on that stream of air. The agitation-froth process is the ball floating in the water. The two things operate upon absolutely different principles, and the difference is so great that it cannot escape anyone's notice.

Dr. Liebmann has characterized this Miami cell, or Callow cell, as he calls it, as an upcast, and the figure of speech is very happy. We took an ordinary upcast with water, such as that which was used for separating the Cattermole granules; and the Court will well remember that the mixture, the granules and gangue, was brought downward into a pipe, and water was flowing upward in the pipe, and that upward stream of water carried off the light tailing, and the heavy granules sank to the bottom. Now, 'upcast' is the term that is ordinarily used, and the action which takes place in this Miami process is absolutely analogous to that. It is not a floating operation. It is an operation in which, in a rising current of air, gravity is strong enough to pull some of the particles down, but the other particles are of such gravity and shape that the rising current of air carries them up against the force of gravity.

THE COURT: Let me ask you, where is the gangue separated from the metal?

MR. SCOTT: In the Miami process?

THE COURT: Yes.

MR. SCOTT: The gangue comes out at the bottom and the mineral is carried over the top.

THE COURT: Yes. How is that the result of this upcast?

MR. SCOTT: Of air?

THE COURT: What is it that separates the gangue from the particles?

MR. SCOTT: The rationale of the thing is evidently this: We have in this cell, or tank with the porous bottom, water carrying in suspension both gangue particles and mineral particles, and the mixture has been treated with some of these agents—tar, or coal tar, or what not—mixed up with it. In the first place, those air bubbles attract to themselves the mineral particles and do not attract the gangue particles; so that at that stage of the operation we have in the water a series of bubbles with the mineral particles sticking to them, and we have the gangue particles free in the water itself. Now, those bubbles rise, of course, by gravity and carry with them those mineral particles. The combination of the bubble and the mineral particle is together lighter than water, so it goes to the top.

THE COURT: I understand.

MR. SCOTT: And the gangue particle has had no assistance whatever from the air. It is still heavier than water, the way it always was, and it goes to the bottom.

THE COURT: I understand, then, that in the Miami process the bubble attaches itself to the mineral below the surface.

MR. SCOTT: Below the surface, yes.

THE COURT: And carries the mineral—

MR. SCOTT: Up to the top.

THE COURT: Up to the surface, or above the surface?

MR. SCOTT: Precisely.

THE COURT: Now, where in the complainant's process does the bubble attach itself to the mineral—below the surface or above?

MR. SCOTT: I think that must be below the surface, too.

THE COURT: And it carries it up, does it?

MR. SCOTT: It carries it up to the top.

THE COURTS Now, you may assume that I do not know froth, rather than of concentration—the difference between the two processes? I understand that the purpose of the patent is to effect not a froth, but a concentration.

MR. SCOTT: Precisely.

THE COURT: A separation?

MR. SCOTT: Precisely.

THE COURT: Now, you may assume that I do not know anything about this. I want to have it put to me as plainly as you can express yourself. What is the distinction in principle between those two processes? You have explained the difference in point of actual operation. Now, what is the distinction in principle, when it comes to the formulation of any principle, between these two operations, as bearing upon the question of the separation and saving of the metal particles?

MR. SCOTT: The broad principles are the same in both. In both we have the pulp, consisting of ore held in suspension in water. In both the water is modified

to lower its surface tension. In both the buoyancy comes from air bubbles. The difference comes after the air bubbles have attached themselves to the mineral particles. In the agitation-froth process the air is beaten into very minute bubbles, and when they rise with these mineral particles they form this permanent froth. The permanent froth is then floated off or skimmed off. Now, in the Miami process there is no beating up of the liquid, of the pulp. The bubbles are larger and more fragile, and instead of forming a permanent froth, which will float, the thing is simply pushed off by the current of air. The basic principles are the same in both of them. The method practised at Miami is the older of the methods. It is the method of the patent 793,808, with the perforated spiral coil.

Now, speaking so far as patents go, departing from the Court's question as to the general principle of the thing, which is identical up to the point I have explained—departing from broad explanations and approaching it from the patent side purely, the patents in suit must necessarily, if they have any validity whatever, be restricted to this permanent froth formed by this mechanical agitation, or they must confessedly be invalid by the prior existence of the perforated coil-pipe machine.

THE COURT: Let me ask you another question.

MR. SCOTT: Certainly, I am very glad to have you do so.

THE COURT: When was the perforated-coil machine first used?

MR. SCOTT: As far as the record in this case shows—

THE COURT: I mean with respect to the first patent in suit.

MR. SCOTT: The date of the application was about a couple of years before, and I think the patent was granted about a month before the application in this country. I will give you the exact dates.†

THE COURT: I mean, was it before?

MR. SCOTT: Oh, absolutely.

THE COURT: Before the first patent in suit?

MR. SCOTT: Before the first patent in suit.

THE COURT: Now, let me ask you, what were the ingredients that were used, and what proportions were used?

MR. SCOTT: In this patent the ingredients—and, of course, in all of these—are the ore-pulp in the first place: the water and the ore.

THE COURT: Yes.

MR. SCOTT: And the ingredients for effecting bubble formation in this patent 793,808 are oils, grease and tar, or any similar substance, which has a preferential affinity for metalliferous matter over gangue.

THE COURT: And in what proportions?

MR. SCOTT: The proportions are stated in the patent in this language—there are no figures—in line 89 of the first page of that patent:

"We have also found that a particle of metalliferous mineral, if coated with a minute film of oil, grease or the like* * * * "

And so forth. That expression, "minute film" certainly gives us indication of a very small quantity, because the word 'film,' without any qualification whatever, conveys to the mind the idea of a very small amount; and when you say "a minute film" we are getting about the strongest expression of the necessity of a small quantity that words can convey.

There is one other place in this patent where I think the quantity is similarly characterized.

MR. SHERIDAN: At the top of page 2.

MR. SCOTT: "A small proportion of oil," following the "minute film."

This brings us, of course, to what I regard as the only real question in the case, and that is as to whether there is any distinction in principle between the froth which is formed with a very small quantity of oil and one which is formed with a larger quantity; in other words, whether there is a difference between an air-froth and an oil-froth.

†[The coil-pipe patent (No. 793,808) is dated July 4, 1905, but the application was filed on October 5, 1903. On the other hand the basic agitation-froth patent No. 835,120 is dated November 6, 1906, while application for it was made on May 29, 1905.—EDITOR.]

EXPLOSIVES. The use of liquid oxygen in explosives promises to be considerably developed in the future. In the early experiments of Linde, the liquid containing 50% of oxygen, which was obtained from his original apparatus, was poured onto fragments of wood charcoal, from 2 to 4 millimetres in size. The fragments were kept from scattering, as the liquid boiled, by making them into a sponge with one-third their weight of cotton-wool. In more recent experiments, at the cutting of the Simplon Tunnel, a mixture in equal proportions of carbon and petroleum, which took up eight parts of liquid oxygen, was used with some success, and lately excellent results have been obtained by Messrs. Claude and D'Arsonval working in collaboration for the French government. The chief object of their investigations was to produce an explosive which gave rise to no injurious gases. For this purpose a mixture of powdered aluminum, with an excess of liquid oxygen, was tried, with a very encouraging success, and the explosive was found to be equal to twice its weight of gunpowder. Further experiments by the same investigators with carbon-oxygen explosives show that these have the same power as dynamite, and, as the cost of each of the constituents is less than two cents per pound, it is predicted that the new explosive will, as soon as further experiments are completed, be widely used. The principal difficulty in the way of its adoption is the transportation of the liquid oxygen, but this should shortly be overcome. —*Engineering*, London.

THE EXISTENCE of gold in the Klondike was known to the officials of the Hudson's Bay Company as early as 1850, but their fear that the miners would frighten away the fur-bearing animals caused them to forbid their employees to divulge the mineral wealth of the country.

How My First Introduction to Flotation Bubbles Cost Me Hard Labor and More Bubbles

By BEN. S. REVETT

As a preface to my first introduction to the separation of minerals by flotation, I think it may not be amiss to relate an incident that has led me at various times to investigate propositions outside my own branch of engineering.

In the early seventies in my collegiate days, I belonged to a volunteer corps, and at the time of the Wimbledon meeting, when all the rifle-shots of the British Isles and Colonies gathered for their annual sharp-shooters' meeting, I was returning home dressed in my regimentals, the only other passenger in the first-class compartment of the London & South Western railway being an apparently well-to-do farmer, his only package a wicker hamper about the size of a modern automobile lunch-basket. My curiosity was aroused by hearing something moving inside, whereupon I asked, "Pardon me, Sir, but are those puppies you have in your hamper?" "No, pigeons." "May I ask what you do traveling around the country with pigeons?" "Fly 'em." (As I could not disassociate my traveling companion from doing anything except for commercial reasons.) "Pardon me, I trust you will not think me rude, but is there any money in flying pigeons?" "Naw, it's a 'obby; volunteering, young man is your 'obby or you would not be wearing that uniform. You are not doing it for money—flying pigeons is my 'obby, and there is no money in it, and I am not doing it for money but just because it is a 'obby. Young man, let me tell you that any man without a 'obby is a Hass."

This episode I have never forgotten. In consequence I have at times profited and at other times lost both time and money in following up someone's hobby, but I have always thought it well worth while to investigate anything new to which another man had devoted time and serious study, particularly in these days of specialties.

As a result, in the winter of 1889 and '90, while spending several months in California, Idaho, and Oregon, in the pursuit of my own hobby, alluvial mining, I drove out one day to Sparta, a small mining settlement about 40 miles north of Baker City, Oregon, to investigate some placers. Going into the general store, the only pretentious building in the town, I was amazed to find a man of most generous proportions, who tipped the beam at over 300 pounds, clad in a Prince Albert coat and silk hat, discoursing to a motley gathering of stove-pipe miners and others. At first I thought it was some patent-medicine vendor, but on listening I learned that he was telling them of a patent process for the separation and concentration of minerals by grease flotation. Upon walking up, the stout gentleman introduced himself as Mr. Criley, part owner and associate patentee of the Criley & Everson Oil Flotation & Concentration Process, of which he had just completed making a simple demonstration. I said: "Why, Mr. Criley, you are making a decided jump against all known metallurgical practice, as at present grease of all kind is avoided in amalgamation, and mill-men avoid making slime." "True," he said, "that is what Mr. N. P. Hill, the smelter-man of Denver, told me, when he laughed at me, as I suppose you are going to do." I said, "No, Sir, I am not going to laugh at you because seemingly you have a hobby, for I have learned that it is interesting to listen to any man who has devoted time and serious thought to any particular subject, and therefore I should be glad to listen to you." He said, "Well, at least you will admit that unless something new was discovered from time to time the world would stagnate and everything come to a standstill." I said, "On that, Sir, we are agreed." Whereupon Mr. Criley told me of the discovery of Mrs. Everson, his associate, of the flotation of minerals by the reduction of specific gravity when enveloped with grease or oily substance, that he was a mechanic and millwright, and that he and Mrs. Everson were partners in the company, that he had a small model, which he took with him for exhibition purposes, and that he had his plant practically complete with the exception of a cheap filter to re-use his acid and oil after the minerals had been extracted therefrom.

Mr. Criley made me the proposition that if I would take a fair sample of the vein in a near-by mine, and would take it to an assay-office in Baker City, reduce the ore to 60-mesh, have the assayer make an assay of it, that he would bet me a quart of champagne that he could save all the minerals with grease and acid in accordance with the assay, and that he would also bet me another quart of "bubbles" that his tailing would not show a trace of mineral by assay. I took both bets and agreed to carry out the program. The following morning I got up bright and early and went to Mr. Blank's assay-office and asked him if he would lend me a bucking-board as I wished to pulp some ore. He informed me that he had no bucking-board but had a good hammer, anvil, pestle, and mortar, to all of which I was most welcome. I took off my coat at once, rolled up my sleeves, and proceeded with my physical task of reducing some pretty hard rock to pass through a 60-mesh screen. After I had been pounding away strenuously for about one and a half hours, Mr. Assayer appeared standing in the door-way, asking me what in the name of thunder I thought I was trying to do. Whereupon I told him of Mr.

Criley's proposition and our bets. He laughed and said, "You are not chump enough to waste your time on any such fool proposition as that, are you." I replied that I was, and told him of the story of my friend and the pigeons, and that a man without a hobby was a "Hass," that I had found a man with a hobby and wanted to determine which was the ass, he or myself. Another hour passed laboriously along, when Mr. Assayer again came to the door: "Say, I have been thinking this proposition over, and there might be something to the fool thing after all. I will make the assays for you and they won't cost you a cent." "All right, Sir, thank you," said I. "You are Umpire and referee, you shall decide, and also participate in the bubbles whether I win or lose." About 4 o'clock the stage drove up to the door of the assay-office and portly Mr. Criley rolled off the box. Mr. Blank, the assayer, having quartered down the pulp, taken his samples and made his assays, Mr. Criley hung his Prince Albert, silk hat, and cuffs on the wall and proceeded to get ready for business by asking for a wash-bowl, hot water, some sulphuric acid, and some grease, all of which were cheerfully furnished by Mr. Blank, the assayer, who, by this time, was as much interested in the bubbles—of course I mean the flotation bubbles—and the experiment as I was myself. Mr. Criley filled an earthen bowl with hot water and enough sulphuric acid so that the acidity was just susceptible to the taste, thoroughly impregnating his pulp with some old signal-oil; he kept stirring and stirring until the bubbles floated to the surface of the water and acid, whereupon he panned them off into a handkerchief that he used for a filter, getting his mineral product on the top of the water and not on the bottom of the water as in the usual method of gold-panning. Stirring and agitating until he could not float any more bubbles, he squeezed his handkerchief containing the product, washed off his tailing, handed them to the assayer for check-assays, with the result that I lost two quarts of "bubbles."

Mr. Criley left next day for Portland, and at the depôt, searching for some baggage of mine that had been lost, he got into conversation with the owner of a fish-oil refinery, from whom he learned about a filter, an English invention the patent on which had expired. This, in his opinion, was the one thing lacking to make the Criley-Everson process a commercial success.

As a result of listening to a man's hobby, I saw practically one of the first demonstrations of the Criley-Everson flotation process, which is now conceded to have been the pioneer of oil-flotation methods of concentration.

TRIBOPHOSPHORESCENCE, or phosphoresence by friction, is shown by ore from Mariposa county, which exhibits a train of light when scratched by a nail. This striking phosphorescence has led some persons to think the ore contained radium and a patent-medicine company is said to use this phenomenon to advertise a nostrum. The mineral in this Mariposa ore is sphalerite, or zinc-blende. This phenomenon is also shown by sphalerite from Utah, which gives off a yellow light when rubbed with the finger or a match. When a steel brush is pressed against the powdered mineral glued on a cardboard disc that is made to rotate 12 r.p.s., the light is visible at a distance of several yards. Chlorophane shows a bright-green color that lasts 0.40 second; this is best obtained by friction of a specimen against a grindstone or corundum wheel. Dr. George F. Kunz finds a zinc-blende from Utah the most luminescent substance known. Two fragments one fourth the size of a pea, if pressed together lightly with the fingers, caused a brilliant yellow-green light to flow as long as the pressure lasted. This zinc-blende was radioactive to the *beta* and *gamma* rays of radium; it was the first natural blende examined that possessed this remarkable property. Quartz, corundum, pectolite, limestone, and willemite possess tribophosphorescence, but to a less degree than either chlorophane or zinc-blende.

CLEVER SALTING. The engineer who is engaged in mine examination should distrust every person who has any chance of tampering with the deposit he is examining or with the ore samples that he takes. This rule should be especially observed by the engineer when in strange lands. An interesting case of 'salting'—the victim was an English engineer—took place in Brazil a few years ago. The engineer had examined a gold placer and found it not quite rich enough for his clients, but noticing the rough edges of the nuggets, and the presence of some crystalline gold, he came to the conclusion that the gold had not traveled far. On communicating his theory to the natives they assisted him in prospecting for the 'mother lode' and his researches led him to a ridge of soft shale at the head of the little valley in which the placer was situated. No quartz could be found, and thinking that the quartz-vein might be covered by surface soil, a trench was run at right angles to the strike of the slate; careful panning of every foot as the trench advanced showed nothing of value for the first 10 ft. and then a small amount of gold for a width of a few feet. Cheered by this verification of his theory, though somewhat disappointed by the small quantity of gold found, another trench was started parallel to the first and higher up the ridge; here the ore-belt was found to be wider and richer and finally a whole series of trenches developed an ore-zone half a mile long and with a maximum width of a hundred feet. The application of the transit, slide-rule, and trigonometrical tables proved a valuable orebody; the property was bought for a good price and preparations made for working the mine on a large scale, but on starting actual work it was found that the only gold in the trenches was the 'salt' put there by the amiable owners of the property. The net result was a loss of reputation by the engineer and some $200,000 by his clients.

The Brazilian native is an ingratiating creature; so humble in his self-depreciation; so overpowered by the vast knowledge and technical skill of the modern scientific engineer from Europe or America that it is hard for the visitor to realize that the native is in reality a master-miner and that when he has finished with a placer claim there are no profits left for a stock company.

Coarse-Crushing Plant of 1000 Tons Capacity

By G. O. BRADLEY*

†In recent years the equipment and arrangement of crushing plants are receiving the same careful study and attention on the part of mill-men and engineers that is devoted to the other departments of modern reduction works. This general awakening of interest is evident from the fact that we now have in operation many efficient crushing installations that compare most favorably with the other departments as regards economical performance. We have passed beyond the age of grossly light and inefficient apparatus for this important work, and one can plainly see the results reflected in the cost-sheets of our up-to-date plants.

We now have on the market various types of crushing machinery, which have been developed and perfected after years of experience. For this we are indebted in a marked degree to the manufacturers, as they have willingly supported us with their own engineering skill, as well as liberality, in the replacing of machine-parts that may have proved inefficient or not suited to the service required. Today, the engineer has at his command a most complete line of primary-crushing and coarse-grinding machinery. In my opinion, the following classification may safely be followed in making the proper selection of a primary crusher that will give the best results on a given ore:

Character of ore.	Type of crusher recommended.
1. A hard, tough, sharp-breaking rock	(a) Gyratory crusher
	(b) Jaw-crusher
	(c) Edison rolls crusher
2. Medium-breaking ore	(a) Gyratory crusher
	(b) Jaw-crusher
	(c) Fairmount crusher
	(d) Edison rolls
3. Soft, easy-breaking, clayey ore	(a) Fairmount crusher
	(b) Edison rolls.

The Fairmount crusher is a new development in primary crushing machinery; its design is along the lines of a compromise between the Edison rolls and the jaw-crusher, in that it has a single segmental jaw and a single revolving hub or core, into which are inserted manganese-steel breaking-lugs or knobules. The jaw is held up to the work by means of massive tension-rods.

It resolves itself, therefore, upon the engineer to select the apparatus best adapted to the particular problem that he is to deal with. It is, of course, important that he should have in his possession all the data relative to the plant requirements and the character of ore to be treated, and in this connection I have outlined the principal subjects of information for the general guidance of the designer, as follows:

1. The system of mining employed. This can be divided into two classes: surface and underground work respectively.

2. The capacity of plant per hour in tons, and the uniformity of the finished product.

3. Nature of the material to be crushed, degree of hardness, and moisture characteristics.

4. The proper placing of the plant in its relation to the other departments.

5. Mechanical efficiency, accessibility to all working-parts of the machinery, and the economy of operation.

6. The type of power available.

7. Class and type of construction.

8. Lighting, heating, and ventilation.

Surface mining requires, as a rule, massive equipment for primary crushing, for the reason that it is necessary to rough down the large pieces of rock too cumbersome to be handled economically within the limits of a finishing plant: therefore, in the case of steam-shovels or surface mining, the gyratory crushers shown should be preceded with a primary crushing or roughing plant.

The arrangement of the plant selected to accompany this discussion is illustrated by the accompanying drawings, Plates I, II, III, and IV. The design is offered with a view to answering the general requirements of coarse crushing as applied to any system of underground mining where it is desired to produce a finished product for subsequent milling operations. In the selection of the design, I have been governed by the following general conditions.

Flow-Sheet: The primary ore to be delivered to the crushing plant at the receiving point above the grizzly-screens, or it can conveniently be delivered directly into the coarse-ore bin, as shown on Plate III under the notation, "Alternative delivery point for the coarse ore."

The ore is fed from the bin into the gyratory crushers, which, after crushing, discharge into the receiving-pockets, from which it is elevated by means of the automatic skips and discharged over the grizzly.

The oversize returns to the coarse-bin by gravity for re-crushing, and is retained in this closed circuit until it is fine enough to pass the grizzly. The undersize is fed onto a conveyor by revolving drum-type feeders and is conveyed to the fine-ore bin, more plainly shown on Plates I and II.

From this point, the ore is fed uniformly over the dry impact-screens, and the oversize is collected on the

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lateral conveyors, which discharge into the 54 by 20-in. rolls.

The undersize from the impact-screens is discharged onto the conveyor for the finished product, as indicated more clearly on Plate II.

The ore, after passing the rolls, falls by gravity into the receiving-pockets, and is charged automatically into the skips and returned to the fine-ore bin, where the above process is repeated until the ore is reduced sufficiently to pass the ¼-in. mesh screens.

Type of Plant: Dry crushing.

Capacity: 1000 tons per day.

Material: Ore of average hardness, and such as produced by the present practice of underground mining.

Equipment: Arranged for graded crushing and rolling, with oversize return.

Product: Finishing to pass through ¼-in. mesh screen.

Power: Electricity.

Construction: Concrete and steel throughout.

A general description of the equipment to be in accordance with the following discussion under their respective sub-headings:

Building: The building to be of concrete and steel construction throughout, having the coarse and fine-ore bins in alignment at the head of the mill, and arranged for electric crane-way over the entire operating-floor. All crushing machinery and auxiliary apparatus to be installed on a single level, so as to minimize attendance and facilitate maintenance and repairs. The fine-ore bin to be constructed with the suspended-type steel bottom, which is more clearly illustrated on Plate II.

Crushers: The crushers contemplated for this installation are two No. 7 gyratory type, standard discharge, set to crush 2½-in. ring gauge.

Feeders: Each crusher is fed by an individual drum-type revolving feeder, placed at the side of the coarse-ore bin. The feeders are provided with proper housing and hand-operated geared cut-off gates between same and the ore-supply. The feeders are driven from the crusher pinion-shaft, thus insuring, automatically, a stoppage of feed when any one of the crushing units is not in operation.

Rolls: The 54-in. diameter by 20-in. face rolls proposed for this installation are of the heavy-pattern self-contained type. In each case the stationary rigid-roll shaft is provided with outboard bearing. The driving-pulleys are both mounted on the same side, in order to give a much greater factor of safety and freer access to the operator when making repairs or inspection of the running machines. The rolls are designed for a combined working load or spring capacity of 15,000-lb. pressure per inch of width on the roll-face. The main driving-pulley for each set of rolls is of the heavy fly-wheel type, 108-in. finished diameter by 17-in. crown face. The hubs and rims are of cast-steel, and the centre is formed by two steel-web plates ½-in. thick dished so as to give lateral stiffness. These plates are riveted to the hub and rim castings by machine-turned through-rivets. The approximate weight of each pulley is eight tons. This heavy fly-wheel has the effect of producing a steady and smooth-running unit, and increases the efficiency materially.

Feeders: The undersize ore is fed from the fine-ore bins by revolving or drum-type feeders, illustrated in section on Plates I and II and in plan on Section BB, Plate I. The ore is fed uniformly over the impact-screens, where the oversize is collected onto the belt-conveyor feeder, which carries same to the roll units. The undersize or finished product is collected by the branch launders and delivered onto the conveyor, where it is transported to the sampling and fine-grinding departments for further treatment.

Drives: The conveyors, feeders, and screen drives are taken from the roll shaft, as it will be noted that each set of rolls is provided with an independent nest of feeders and screens. The main drives consist of two 150-hp. motors of the double-end type, having a flexible coupling connecting the transmission shafts at each end, also a friction coupling or cut-off which enables the operator to run any machine independent or together as may be desired. This system of drives applies to both the crushers and rolls, as is clearly shown in Plates I, II, and III.

Automatic Skips: The crusher and roll units are each provided with balanced automatic skips in place of the belt-elevators commonly used for this class of work. The advantages of the skip over the belt-elevator are numerous. The skips are more wieldy and can operate to any height desired, making it possible to concentrate the equipment and operating labor, at the same time avoiding all the annoying evils so prevalent in connection with belt-elevators.

The operation of the balanced automatic skips will be in accordance with the following general description:

The arrangement of the loading apparatus at the bottom of the shaft is such that when the empty skip comes into place it engages the automatic-skip loading-mechanism, which closes gate *U* completely; then gate *R* starts to open. The measuring-hopper holds, when filled, one skip-load. As the weight of the load increases, the loaded skip compresses the weighted platform at the bottom of the shaft, overcoming the resistance of counter-weight *T*. This movement is sufficient to trip the lever operating a master controller, which automatically starts the hoist. As skip *B* starts to ascend, the engaging mechanism follows with it, due to the over-balancing of counter-weight *S*. The first cycle closes gate *R* completely, and as the skip continues on its upward movement gate *U* opens and remains in this position until the skip returns on its downward travel.

A geared limit-switch of the traveling-nut type is mounted on the hoist and so arranged as to allow the hoist to coast momentarily when either of the skips approaches the dumping position. Just before the skip

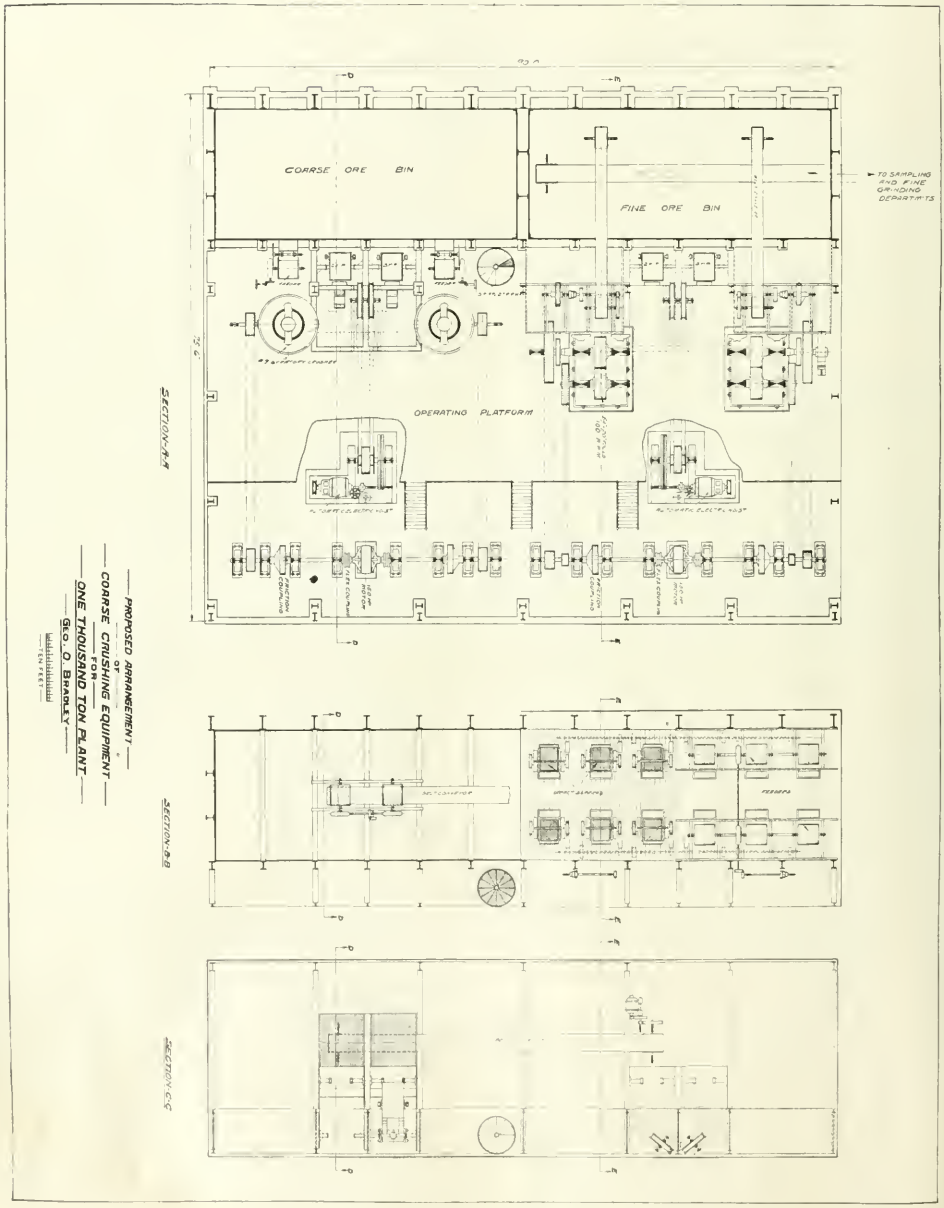

COARSE ORE BIN
FINE ORE BIN
TO SAMPLING AND FINE GRINDING DEPARTMENTS
OPERATING PLATFORM
SECTION A-A
SECTION B-B
SECTION C-C
PROPOSED ARRANGEMENT OF COARSE CRUSHING EQUIPMENT FOR ONE THOUSAND TON PLANT
GEO. O. BRADLEY

PLATE I.

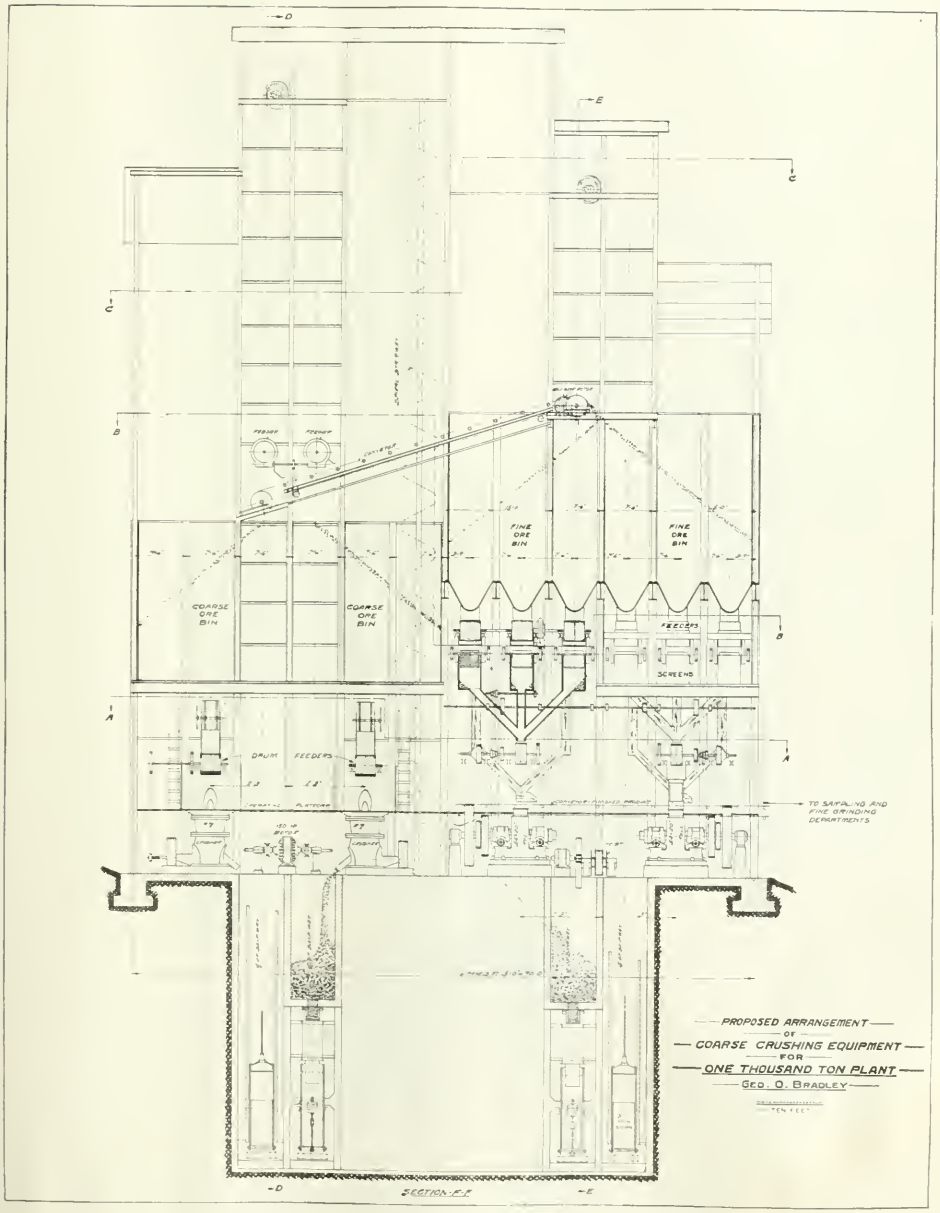

D
E
C
B
A
COARSE ORE BIN
COARSE ORE BIN
FINE ORE BIN
FINE ORE BIN
FEEDERS
SCREENS
DRUM FEEDERS
TO SAMPLING AND FINE GRINDING DEPARTMENTS
PROPOSED ARRANGEMENT
OF
COARSE CRUSHING EQUIPMENT
FOR
ONE THOUSAND TON PLANT
GEO. O. BRADLEY
SECTION E-E

PLATE II.

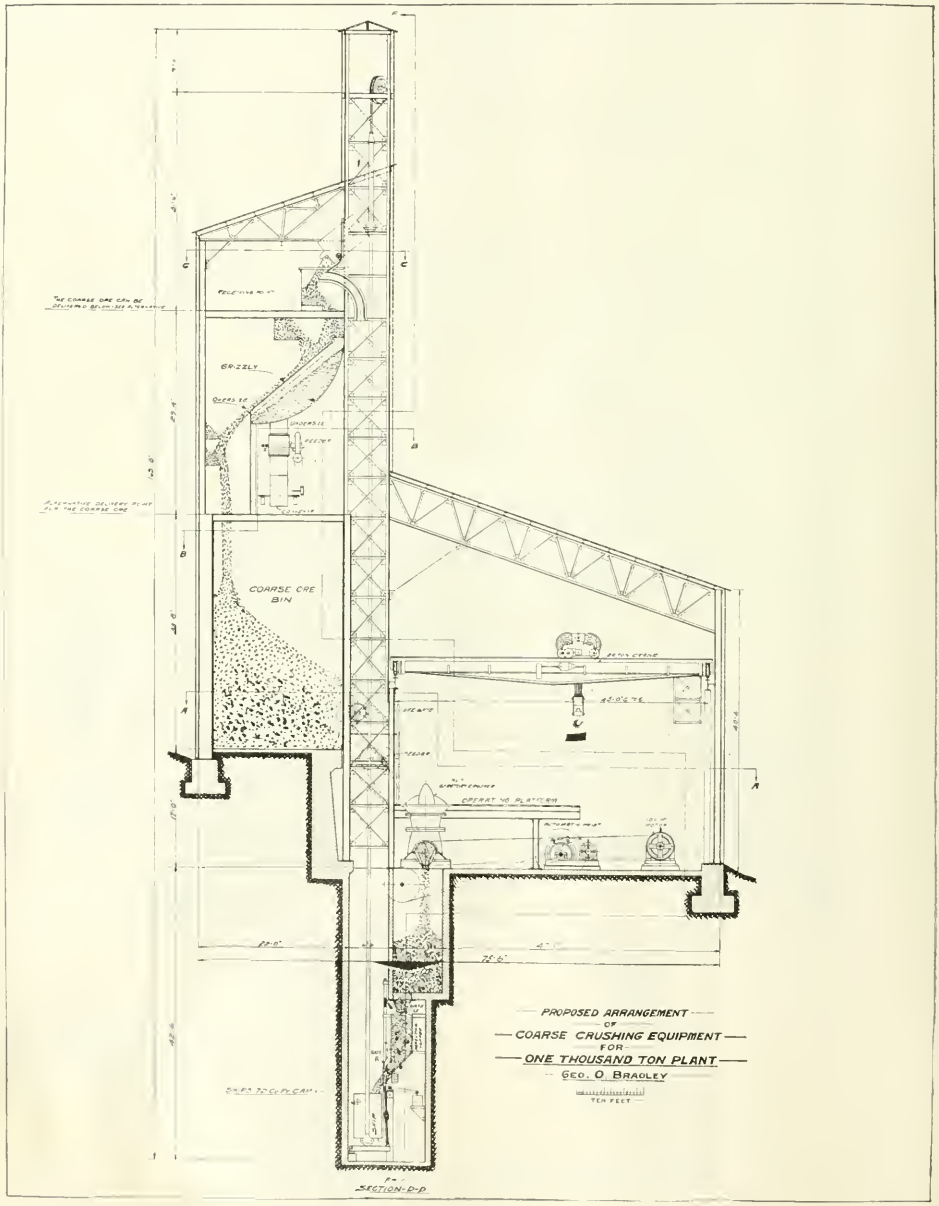

GRIZZLY
COARSE ORE BIN
PROPOSED ARRANGEMENT
OF
COARSE CRUSHING EQUIPMENT
FOR
ONE THOUSAND TON PLANT
GEO. O. BRADLEY
TEN FEET
SECTION D-D

PLATE III.

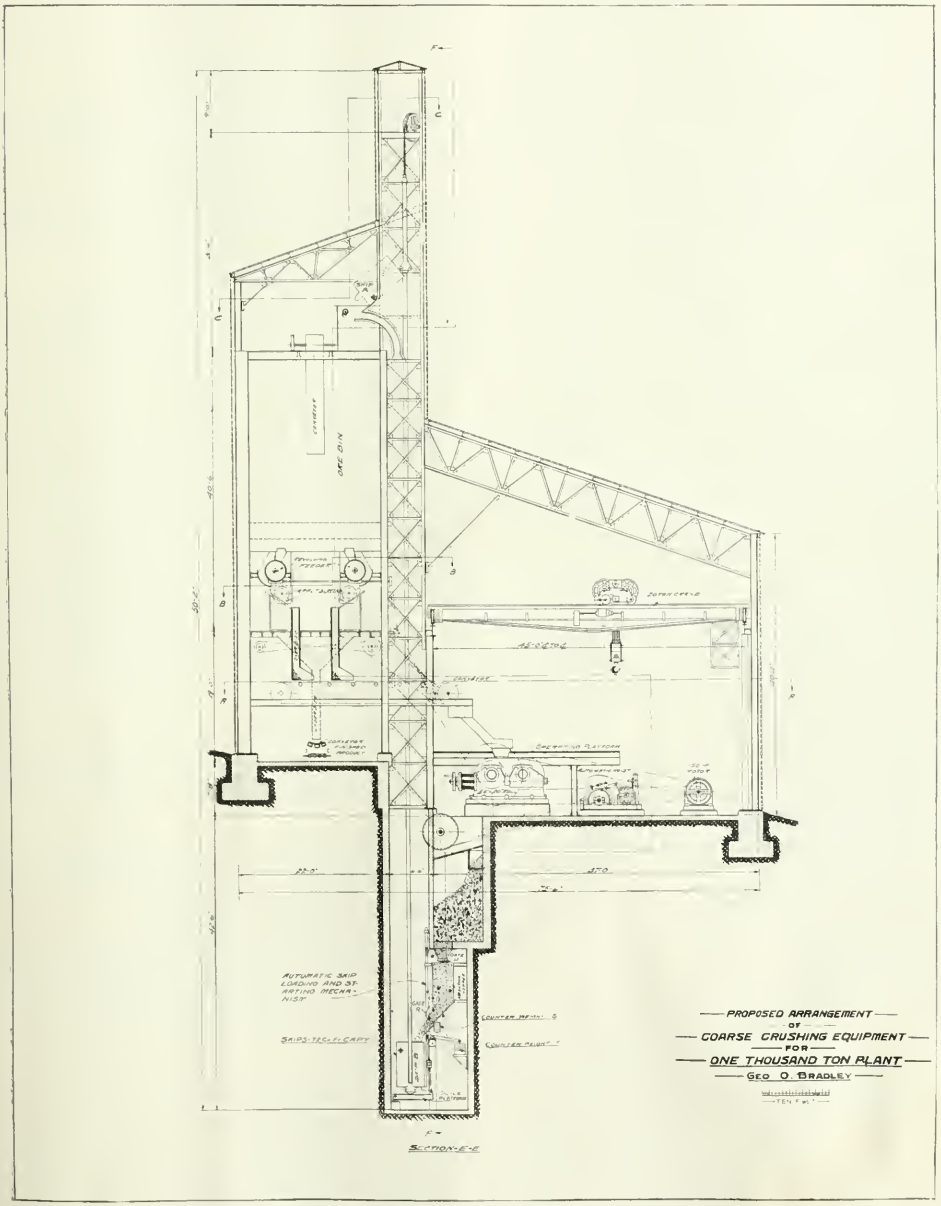

PROPOSED ARRANGEMENT
OF
COARSE CRUSHING EQUIPMENT
FOR
ONE THOUSAND TON PLANT
GEO O BRADLEY
SECTION E-E

PLATE IV.

reaches its proper limit of travel, the limit-switch will automatically de-energize the solenoid brake, thus bringing the hoist to rest. Hatchway-limit switches are also placed in such a manner as to be operated by the motion of the skip itself. These hatchway-limit switches will serve as an additional precaution in case of failure of operations of the geared-limit switch. The master controller is also inter-connected by means of a double-throw knife switch, so that hand operation may be obtained at the will of the operator. The automatic master controller will have only three points, namely, a neutral position at the centre of throw and a position on each side of the centre for either direction of hoisting.

ESTIMATED COST

Building:		
Grading	$ 2,000	
Concrete	6,000	
Steel, building	31,500	
Steel, corrugated	2,085	
Sheathing and nailing strips	900	
Doors and windows	1,600	
Floors	360	
Grizzlies	385	
Stairs	750	
Lighting and wiring	2,300	
Launders	300	
Crane	4,000	
Painting	800	$ 52,980
Equipment:		
2 No. 8 crushers	8,100	
Freight, at $1.50 per 100 lb.	3,045	
Erection, at $1.50 per 100 lb.	3,045	
2 Gates and special chutes	90	
4 feeders	500	
12 feeders	1,500	
12 impact screens	2,760	
2 54 by 20-in. rolls	10,650	
Freight at $1.50 per 100 lb.	3,803	
Erection	2,500	
2 automatic hoists, complete	13,800	
4 loaders	1,680	
2 150-hp. motors and starters	3,900	
Complete transmission, belting, etc.	2,900	
Complete conveyors and drives	1,050	59,323
		$112,303
Miscellaneous and supervision, 5%		5,615
Total estimated cost		$117,918

The method of the operation and control will be as follows:

Assume that skip *A* is being hoisted and skip *B* being lowered. Just before the skip *A* reaches the dumping point, the hoist will be slowed down by gravity to approximately half-speed. When skip *A* has reached a point perhaps two feet from its final position, skip *B* will engage with the scale platform, depressing the latter for a short distance and increasing the load upon the motor by increasing the unbalanced effect of the upper skip. When skip *A* reaches its final limit of travel, the solenoid brake will be applied by means of the limit-switch. Skip *B*, however, will have to come to a standstill in the meantime, so that there will be a small amount of slack in the *B* cable. The ore now being dumped into skip *B* will cause a further depression of the platform and a movement of one of the operating arms attached to the automatic master. The latter, which has been in the proper position for hoisting skip *A*, will have its handle pushed past the neutral position and into the position for hoisting skip *B*; it will be held in place by a roller falling into a notch on a star wheel. Since the limit switch will offer no opposition to hoisting skip *B*, the latter will now start to rise. Retardation will then take place when skip *B* reaches the upper end of its travel, as previously described in the case of skip *A*.

Ferrous and Ferric Iron in Cyaniding

By WILL H. COGHILL*

What would cause a tailing that seems perfectly amenable to cyanide when taken direct from the pile, to show a prohibitive consumption of cyanide after being dried and crushed on the bucking board? The presence of ferric sulphate.

The tailing contained soluble iron salts. Before recrushing it contained 0.045 and 0.172% soluble ferrous and ferric iron, respectively. In laboratory parlance, it was dry when put through the disc pulverizer. After once through: soluble ferrous iron 0.18%; five times through, 0.203%; fifteen times through, 0.213%.

The above determinations were made after a three-minute water wash. It is possible that metallic iron from the crusher reduced some of the ferric iron during the wash, but a lime-water wash followed by cyaniding showed an increased cyanide consumption of about the same degree.

One would expect dissolved ferric sulphate to be reduced by metallic iron, but it must be remembered that 'dry' is only a relative term, and if the ore contains soluble ferric sulphate one must use the porcelain jar with flint pebbles for grinding unless the acidity be first neutralized.

Had crushing been undertaken at first instead of testing direct from the dump, the ore would have been condemned as refractory, but fortunately the laboratory and not the ore was found to be at fault.

The books do not warn the experimenter against this snare. In short, no matter how dry your ore is, if it contains ferric sulphate the work done upon it in an iron grinder or on the bucking-board is likely to cause a reaction between ore and apparatus, developing a disastrous cyanicide.

DIAMOND-DRILLING at the Le Roi No. 2. Co.'s Josie mine at Rossland, British Columbia, cost $1.64 per foot during its past fiscal year, when 12,249 ft. was driven. Labor accounted for 72c.; carbon, 60c.; and sundries, 32c. Two shifts required one diamond-setter, four miners, and four helpers.

COSTS at the Goldfield Consolidated in August were $4.86 per ton; mining was $2.56; and treatment, $1.71 per ton.

*Ore-testing laboratory, El Paso, Texas.

Non-Metallic Products

Compiled by S. H. DOLBEAR

Dolomite Uses and Production

But little attention has been attracted by the dolomite industry in California, although the amount consumed has increased considerably during the past few years.

Dolomite is a carbonate of lime and magnesia containing, when pure, 60% calcium carbonate and 40% magnesium carbonate. Impurities usually exist in the form of silica and silicates, and not infrequently metallic oxides or sulphides. Much of the California mineral contains perceptible amounts of iron pyrite.

The Columbia Marble Co. mines large quantities of dolomite from its quarries in Tuolumne county. This is shipped to the company's plant at San Francisco, where it is sawed into shapes and used for structural purposes. The spawls or scrap resulting from this operation, amounting to several hundred tons per year, are sold for industrial uses. Aside from this source, large amounts have been mined in the vicinity of Hollister in San Benito county, the latter output having been taken largely by local steel plants.

In addition to that used for structural purposes and in the steel mills, dolomite is crushed and closely sized by screening, and employed in artificial marble-work, terrazzo floors, and to some extent in the manufacture of roofing. The smaller sizes are sacked and sold for chicken grits.

Inyo County Pumice

Large deposits of pumice and pumiceous rock are found eight miles northeast of Little Lake, a station on the Aqueduct branch of the Southern Pacific railroad in Inyo county, California. This region is characteristically volcanic. A narrow bed of lava extends toward Indian Wells valley parallel with the Sierra Nevada a few miles west. At Coso Springs, three miles distant, is a solfatara. Sulphur, alkaline substances, silica, and metallic sulphides are being constantly brought to the surface by hot solutions, the metallic sulphides containing traces of both gold and silver.

The pumice deposits were taken up several years ago by San Francisco people, who mined several hundred tons. The claims lapsed and are now controlled by the C. W. Hill Chemical Co., of Los Angeles. This concern has made some shipments to Los Angeles, where the material is ground and prepared for market in the company's mill.

Much of the pumice found here is friable and may be reduced to a coarse sand by rubbing between the fingers. Fragments of more solid pumice are found, selected pieces of which have been pronounced by experts to be equal in quality to that of the Lipari islands, from which place most of the pumice of commerce is now obtained.

The occurrence of pumice in California is by no means limited to Inyo county. It is found in large quantities in Mono county, Shasta county, and in the vicinity of Salton Sea.

Industrial Applications of Quartz

The development of the non-metalliferous quartz business in the western part of the United States commenced with the advent of smelters, its first demand being for use with heavy sulphide ores having low silicious content. There is still some demand in this direction, although the development of the mining industry has made it possible for most smelters to secure silicious ores with sufficient metal content to pay expenses.

The second step in the development of this business was the attempt of glass manufacturers at San Francisco and Los Angeles to grind quartz as a substitute for Belgian and other sand. Neither attempt was successful, the expense of crushing being so great that the resultant product could not compete with the imported sand.

At Los Angeles, the Southwest Glass Co., which later became known as the Quartz Glass & Mfg. Co., while obliged to discontinue the attempt to manufacture bottles from quartz, found that a market could be developed in various industries for quartz crushed to various degrees of fineness. Crushed to the size of gravel and coarse sand it is used in the manufacture of artificial stone, in filters, in plastering the exterior of buildings, as chicken grits, etc. Carefully graded, it is used in the manufacture of sand-paper, sand-belts, and in the sand-blast. It is referred to as 'banding silica' when painted upon wood surfaces; the resultant coat being supposed to resist wear better than a smooth surface. Finely ground quartz, when water-floated, is used in the preparation of certain paints and as a wood-filler. Ground crystalline quartz is preferred for this purpose rather than ground silica sand, for the crystalline material is angular and adheres to the surface better. It is used to some extent in the preparation of ready roofing, a product rather coarser than ordinary sand being required for this purpose. It would be used for sawing marble if it could be produced cheaply. When finely ground, dry, in either a mill of the Fuller-Lehigh type, or in a pebble-mill, it is used in the manufacture of abrasive or scouring soaps. In steel-casting foundries it is washed on the surface of molds to fill voids in the mold surface. Potteries and manufacturers of sanitary ware are among the most important users of quartz, its function being to reduce shrinkage in the body of the ware. For this purpose, as well as in its use as a pigment, it is essential that the iron content be as low as possible, preferably not to exceed 0.5%. In acidic furnaces the coarsely crushed product is required for bedding. Boulders and large blocks of quartz are used in acid towers.

Quartz for miscellaneous industrial uses in California is derived from two sources, as boulders either from glacial deposits or that resulting from the disintegration of rocks in which quartz is abundant; and second, from veins and deposits of the mineral.

The cheapest source by far is the boulders, which require only to be gathered and hauled to the point of shipment. Quartz has been mined, however, in large quantities from deposits in Amador, Placer, Tulare, Riverside, Kern, and Los Angeles counties, as well as some other places in the state. Boulders occur abundantly, particularly in the northern half of the state, in Calaveras, Placer, Alameda, Sacramento, El Dorado, and other counties.

No separate statistics of quartz production were kept by the State Mining Bureau prior to 1913, when a yield of about 4000 tons was reported. This includes only shipments from Amador, Placer, and Tulare counties, no figures being given for southern California deposits, so that it is difficult to determine the exact extent of this important industry. In California the value of the crude material varies from $1.50 to $6 per short ton at the point of shipment. The variation in value in each case depends upon the distance from rail and the relative ease with which the mineral may be mined or gathered. Statistics of production are customarily combined with those of feldspar, glass sand, quartz sand, crushed rock, rubble, etc. The industry in California is now of sufficient importance to justify the segregation of quartz from other substances.

Magnesite

The Fresno Magnesite Co. is now employing a crew of 10 men in development work at Piedra, Fresno County, California. A shaft has been sunk to a depth of 250 ft., and ore is being exposed in laterals at this depth. The old adit intersects the shaft at 150 ft. below the outcrop. About 500 tons of good ore is now on the dump, all of which was broken during this development period. The mine is conveniently situated for transportation, a spur of the Piedra terminal of the Santa Fe railroad extending within half a mile of the company's plant, which includes a kiln of the stack type, built of reinforced concrete and stone, the calcining capacity of which is 12 tons of burned magnesite in 24 hours. Oil-fuel is used. The hoist and other machinery are operated electrically, power being supplied from a recently-built line of the San Joaquin Light & Power Company. The production from this mine to date has been about 4000 tons, nearly all of which has been used by paper-manufacturers in Oregon or Washington.

The deposits of the Western Magnesite Company at Red Mountain in Santa Clara county, California, have been producing and shipping calcined magnesite for several months. Most of the output, it is understood, is being shipped to Chicago or other Eastern points.

At Cedar Mountain, in Alameda county, a lease has been given to San Francisco people on the magnesite deposits formerly controlled by the Jas. H. Swindell Magnesite Company.

A deposit near Porterville, in Tulare county, has been reported sold to B. J. Bither of the Pure Carbonic Gas Co. The ore is to be calcined, and the carbonic acid gas content recovered. Magnesite from Morgan Hill, Santa Clara county, has been calcined recently at the West Berkeley plant of the company, instead of limestone as heretofore, the CO_2 content saved, and the calcined product shipped to a paper-mill in Oregon.

The Rex Plaster Co. has acquired the deposits at Bissel, Kern county, near Mojave, and has erected calcining furnaces. The deposits are of sedimentary origin, the only ones of this character known in the United States. It is reported that the company has contracted for the sale of its entire output.

Miscellaneous

Among the mineral substances used in the manufacture of artificial stone are quartz, granite (red, black, and gray), dolomite, limestone, lava (red and black) slate, actinolite, jasper (red and white), manganese, magnesite, pumice stone, and mineral paints. These substances have also been used with success in plastering the exterior of buildings. An example of this kind of work may be seen in the residence of James D. Phelan at Los Gatos. The exterior of this building was plastered with a mixture of white portland cement and a coarse sand made by crushing white quartz.

The preparation of so-called ready roofing also requires the use of these substances, in addition to which are used mica, talc, soapstone, and other materials. The crude rock is ground, carefully sized by screening, and packed in bags for the trade.

A new use for borax is being advocated by the Pacific Coast Borax Co. Fused borax 'glass' is being placed on the market for welding metals.

An attempt is being made to extract magnesium chloride from the bitter brines at the works of the Long Beach Salt Co. near San Pedro. Analysis of this brine at 30°B. is as follows:

$MgCl_2$	= 17.8%	equivalent to	356	lb.	per	ton
NaCl	= 10.0	"	" 200	"	"	"
Na_2SO_4	= 8.0	"	" 160	"	"	"
$MgSO_4$	= 10.03	"	" 206	"	"	"
KCl	= 3.7	"	" 74	"	"	"
KBr	= 0.08	"	" 1.6	"	"	"
K_2SO_4	= 1.77	"	" 34	"	"	"
H_2O	= 48.42					

Most of the magnesium chloride of commerce is recovered as a by-product from the Stassfurt deposits in Germany. Except for small stocks on hand in this country, very little of this chemical is now available, and inordinately high prices prevail. A little has been manufactured in California by the direct solution of magnesite in hydrochloric acid, but no attempt was made to reduce this to its fused state. When fused it is extremely deliquescent and is packed in sealed iron drums.

Silica sand for use in steel-casting molds must be nearly pure silicon dioxide and must be made up of smooth rounded grains. Sharp edges have a tendency to adhere to the castings. Most of the sand used for this purpose on the Pacific coast is shipped from Illinois.

Points of View From Lake Superior

By P. B. McDONALD

Flotation is being applied experimentally to Copper Country ore. The idea of concentrating native copper by frothing might seem impracticable to an outsider, and so it is to the general run of Lake Superior ores. But down in the Porcupine mountains at the extreme southwestern end of the region, the copper is flaky and fine, being in sandstone and shale. The White Pine property of the Calumet & Hecla, concerning which several happy predictions have been made, is saving what copper it can in its new mill by the usual dressing methods, and later may attempt flotation or leaching to recover the present rather high loss of copper in the tailing. The White Pine Extension is going ahead with flotation experiments assisted by A. J. Houle, professor of metallurgy in the Michigan College of Mines, and, as in nearly all flotation trials, some surprising facts have developed. It may be remarked incidentally that Prof. A. E. Seaman is giving geological advice to the White Pine Extension in its diamond-drilling campaign.

The application of more complicated metallurgy to Michigan copper ores is further indicated by the work being done at the Winona mill. A modification of the Slater leaching process is being applied by the Western Precipitation Co. of Los Angeles. The Slater process has been tried experimentally on 'porphyry' and non-roasting ores; it involves a cyclic treatment using chlorides and electrolysis. The Winona ore, while of amygdaloidal character, is finer and flakier than the usual Lake Superior copper, perhaps by reason of metamorphic crushing. The Winona mill, built several years ago, has undergone much change and experiment. A theoretical description of the Slater leaching process for copper ores by H. W. Morse appeared in the Mining and Scientific Press of January 24, 1914.

Unusual interest is being taken in two exploratory enterprises in the Copper Country. The Keweenaw Copper Co. in its sinking near the old Phoenix mine is said to be getting satisfactory showings of copper. William Uren, formerly with the Calumet & Hecla, is in charge. Keweenaw Copper is an expression of the faith of Messrs. Cole and Hoatson in the reviving of copper mining on Keweenaw point. A number of Duluth and Lake Superior people hold stock in Keweenaw Copper, as both Messrs. Cole and Hoatson have many friends. The other case is that of the Naumkeag Copper Co.'s shaft, at West Houghton, under the direction of Sidney Lang, with which operation J. Parke Channing and the Lewisohn interests are connected. This shaft is so close to Houghton's main street that the operations are watched daily. Close propinquity to a mining town is stimulating to mining developments. For instance, as James MacNaughton of the Calumet & Hecla once said, the Isle Royale mine, which is convenient to Houghton, was developed before its time, that is, years before modern efficiency made the property profitable.

Hard hats (but not boiled shirts) were furnished to the miners sinking the Woodbury shaft at Ironwood, Michigan, by the Newport Mining Co. These were for preventing head-wounds, much as the French soldiers are wearing light steel hats for protection against shrapnel. A discerning English writer has pointed out that in light of the many instances where letters, a Bible, or a coin, in a soldier's pocket have saved his life (ex-President Roosevelt's was saved at Milwaukee in 1912 by the bullet being retarded by his papers) it is strange that light armor for modern soldiers has not been adopted before. In the case of the Newport mine, the hats were made of felt treated with resin and shellac, making a surprisingly hard surface. They proved satisfactory for diminishing the effect of falling rock fragments, a certain amount of which cannot be prevented in a deep vertical shaft such as the Woodbury.

The question is sometimes asked if Safety Departments and Safety First precautions really have a practical effect in reducing accidents. This is pointedly answered by the record of the Cleveland-Cliffs Iron Co. of Michigan. In the four years since the Safety Department was established, there have been 30 fatal accidents in the company's dozen or fifteen mines. During the previous four years there were 55 fatal accidents. The total number of employees has steadily increased, and no large catastrophes intervened to affect the average irregularly. Following is the detailed classification of the company's fatal accidents in the last eight years:

Year.	Deaths ascribed to trade risk.	Deaths ascribed to negligence of the company.	Deaths ascribed to negligence of the workmen.	Total.
Without Safety Department				
1907	4	0	13	17
1908	3	2	1	6
1909	8	1	4	13
1910	6	5	8	19
	21	8	26	55
With Safety Department				
1911	2	1	2	5
1912	0	3	1	4
1913	3	1	7	11
1914	8	0	2	10
	13	5	12	30

This reduction of fatal accidents was accomplished by the permanent employment of a capable man to visit the mines and make recommendations as to safety, which were referred to the superintendents from the company's office in Ishpeming. Particular efforts were also made to secure the co-operation of the miners by conferences with committees of miners, inspections in other mines, and the ordinary publicity methods of teaching 'Safety First.'

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Alumina constitutes about 15% of the earth's crust.

The terms 'potential' and 'voltage' are synonymous, and mean electrical pressure.

The terms 'kilovolt-ampere' (kva.) and 'kilowatt' (kw.) represent input and output respectively of an electric generator.

Winms at small mines should be provided with some arrangement to prevent running back of the bucket used in hoisting ore, waste, or other material.

Open-pit mining (steam-shovel work) is much safer than underground systems; in the former the crews employed are small, and the quantity produced per man is enormous.

Factor of safety in steel hoisting ropes when newly installed in shafts less than 3000 ft. deep should not be less than six; and when the factor of worn ropes is below 4.5 they should not be used.

Loose timber should not be allowed to accumulate in main drifts of mines, as in case of the workings being flooded this material floats about, resulting in injury to men, or blocking cages in shafts or other equipment.

The slide-rule is suggested as a means of computing rock analyses, where certain phases of petrographic and metamorphic work require conversion of analyses into the corresponding approximate mineralogical compositions.

Air-receivers should be blown out at least once per day, so as to remove any accumulation of grease, oil, or other material likely to cause an explosion. The temperature of such receptacles should not be allowed to rise over 250° Fahrenheit.

White chert in the northern deposits of the Cuyuna iron range of Minnesota is often so thoroughly disintegrated that it resembles white flour, which, when in any quantity, will flow like quicksand. This material must be washed from the iron ores.

Hard hats should be worn by men working in shafts. At the Woodbury shaft of the Newport mine, Ironwood, Michigan, the miners were supplied with a hat made of felt treated with resin and shellac. Such hats are hard enough to resist a severe blow.

Mica occurs in 20 States as probable commercial deposits. The matrix of mica is pegmatite, a rock allied to granite in composition, but of much coarser texture. Such pegmatites are associated with crystalline rocks, either ancient metamorphic or igneous rocks. The absence of such rocks indicates the absence of good mica deposits.

Improvements introduced into cyanidation are generally considered to have been mostly mechanical, but J. E. Clennell considers that by a study of the recent history of the cyanogen compounds from a somewhat broader standpoint, it will be found that considerable additions have been made, not only to our knowledge of their chemical properties, but also to their applications for industrial purposes. The treatment of carbonaceous ores and by-products, electrolytic regeneration of cyanide, effect of mineral ingredients in water on cyanide consumption, fixation of atmospheric nitrogen, conversion of cyanamides into cyanides, production of cyanogen compounds from nitrogenous gases by catalysis and otherwise, and production of these compounds from gaseous mixtures by absorption with a metallic salt are all of recent investigation, and of importance to cyanidation.

Back-geared motors are increasing in favor at many mills and other works. From as far away as the Benguet district of the Philippines to the new mills at Rochester, Nevada, and Grass Valley, we hear of them being installed. Why is this method of power transmission gaining in popularity? Some of the reasons are as follows: In ordinary motor-driven plants countershafts are necessary for speed arrangement. These absorb power and necessitate the construction of wood or concrete foundations of some kind, which often are a nuisance, making everything too cramped. Additional belts are also required, with some form of tightener to ensure their adhesion to the pulleys. The running of many line-shafts and belts adds considerably to the vibration of a plant. The back-geared motor may be placed in any situation, so long as the foundation is good. The motor is of the squirrel-cage design, which ensures good results under severe conditions. At the back of the motor are cast two journals in which revolve the spur-wheel gear and pulley shafting, making a self-contained unit. The pinion-wheel is on the armature shaft, and both gear-wheels run in oil or grease in a tight cover. There is no danger, and little noise. The motor drives any unit, such as a crusher, five or ten stamps, or a tube-mill, by means of a belt. As the motor is on a sliding base the belt may be tightened without any trouble, no straining jockey-pulley being required. The individual back-geared motor is better than a large ordinary motor driving a counter-shaft, from which belts drive the units desired. The back-geared motor is of low speed, and the belts are usually short and heavy. Compared with the old driving methods, that is, one large motor, etc., there is a saving of fully 10% in current. The wear on gear is negligible, that at the MacNamara at Tonopah showing no perceptible wear in two years. These motors are made from 10 hp. upward, and may be used for driving any machine with entire satisfaction.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

PLATTEVILLE, WISCONSIN

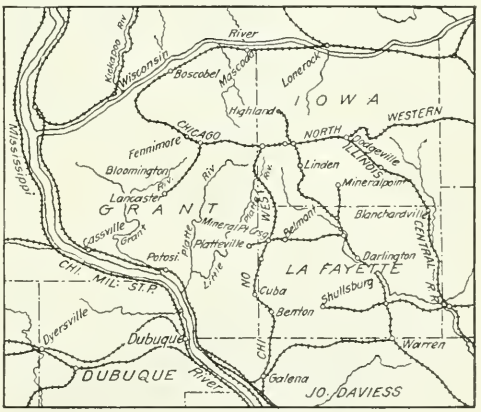
Floods Hamper Operations.—Prices of Zinc Products.—Peculiarities of the Market.—Results of High Prices.—Lead, Pyrite, Zinc Carbonate.—District Outputs.

The Missouri zinc region was not the only one to suffer from heavy rains in September, as the districts around Platteville suffered the same in the last week of the month, especially in the southern parts of the field bordering upon LaFevre river, where most of the large mines are situated. Many producers were seriously hampered by the waters, mine and mill equipment and reservoirs being seriously damaged, while the washing away of bridges and culverts tied up the main lines of railway traffic for several days. Unwatering of the mines was imperative, requiring in several cases weeks of constant pumping operations to put the mines back on a producing basis. At Galena, Illinois, the LaFevre river overflowed its banks, the lower or levee area of the city being submerged to a depth of six feet, compelling the use of skiffs on the main streets of the city.

From the substantial gains in the price of metal from about $10 per cwt. in the first 10 days of the month to $14.50, St. Louis, at the close, it would be inferred that this would have a tendency to increase the price of blende, coupled with a probable curtailed output for several weeks, but the contrary proved true. Further inroads were made into the price of blende, the top range of $70 to $80 per ton received in this field being lowered to $66 to $75. Just why this cut should be made at such a time was not explained properly, since the base range in the Missouri zinc districts held firm all the month at $70 to $80 per ton of 60% zinc content, the standard by which values are based in this field. High-grade product was raked clear of bins at all points, and the buying during the month revealed the fact that lower valued material was finding a ready market. Producers who had piled up a large reserve of lower-grade ore, which they have been compelled to carry for months, are facing the music manfully, because barred from active participation in the selling, and it is hard to believe that they will part with their output, if that were really the move a lower price standard had in view. The reserve at all points in the field at the beginning of the month was slightly in excess of 10,000 tons, and this was reduced during the month to about 7000 tons. Production up to the time that heavy rains interfered was excellent, while deliveries were even better. Bad roads immediately isolated all outlying producers, for which reason some of the districts in the northern half of the field entirely failed to report for two weeks.

One very interesting bit of information came from Luther V. Rice, general manager of the Fields Mining & Milling Co., in the Shullsburg district. This company is made up of officials of R. W. Hunt & Co., engineers, Chicago, who have developed two large mines here, on one of which recently a $75,000 modern plant was erected. In addition, a separating plant was added, and it is in connection with this separating process that the news is concerned: "Handled first 10 days 154 tons 18 to 20% ore, worth about $5 per ton, but absolutely unsaleable. Recovered 52 tons 54% zinc ore sold for over $6000. Roasting and separating cost $300." In other words, Mr. Rice means to convey the impression that he sold this ore under a contract agreement with the New Jersey Zinc Co., receiving under the terms of his contract $111.11 per ton for 54% zinc concentrate, while at that very hour $70 per ton was held out as the price for ore assaying 60% zinc content. This is not true in all instances of ore sold from separating plants in this field. Last June Mr. Rice sold 42% ore for $156.11 per ton under the same contract. Another operator, now the general manager for an Indianapolis mining corporation, interviewed during the month, admitted that he was receiving more for 48% green concentrate than he could obtain for 60% material in open market, so that it would appear that firms with foresight enough to provide themselves with contract arrangements to meet the present abnormal conditions displayed great wisdom. Substantial advances were made at several points in the field in the commencing of new separating plants, giving an outlet to a considerable quantity of crude zinc ore, which must, within the next 30 days, greatly relieve the situation here, as it will practically eliminate the surplus ore now accumulated.

Big profits follow the sale of blende at current quotations,



THE WISCONSIN ZINC REGION.

and the trend in all branches of the industry for several years past has been to secure maximum efficiency at minimum cost, and an average covering all ores produced in this region, both in the dry and under the water-levels, is now a little over $8 per ton, which includes overhead charges and cost of administration. The profits made during the past year gave large dividends, and the greatest period of mine development this field has ever known is under way. In the Benton district alone about 40 drill-rigs are busy. New plants, necessitating large quantities of mining, pumping, and concentrating machinery, are going up at several points; and as many more have been planned for construction before the end of the current year. The transition from a great low to a high-grade zinc-ore producing area by means of better methods of concentration has been accomplished so quickly and well that all are very pleased. Better roads are being constructed to enable haulage during the spring and autumn rains, when the markets may be inviting enough to stimulate prompt delivery of finished product.

Prices for lead concentrate held for a time at about $45 per ton, but a gain was made to $50, offerings which had held for several months. Producers saw no reason to part with

their products, and the reserve at all points was close to 3000 tons.

Pyrite was in poor demand. Crude ore production failed entirely for the month, and such sales as were reported came from the sale of fines recovered as by-product of separating plants; $3.75 to $4 per ton base of 50 units held all the month.

Carbonate of zinc ore producers met with discouraging conditions. The quotations offered by Missouri buyers for calamine ore govern quotations in this field on carbonate of zinc ore, and the highest prices ever recorded were registered, $70 per ton at one time obtaining for 40% ore. Competition developed in one quarter, but such sales as were made went to the Lanyon Zinc Co., a new buying factor as far as this product is concerned. The New Jersey Zinc Co. contends it cannot afford to pay high prices for carbonate ore to convert into 5-cent white oxide. Miners are loath to continue operations against no demand, and production fell off, considerable ore being carried over. The New Jersey Zinc Co., operating with two drills in an entirely new quarter in the Highland district, discovered one of the greatest continuous deposits of this class of ore ever found in the State. The range was proved on a line for more than half a mile, with the rigs still going. The development of this deposit will follow on a very elaborate scale.

The following deliveries of ore were made during September, two working days yet to be added:

Districts.	Zinc, pounds.	Lead, pounds.	Pyrite, pounds.
Benton	14,292,000	.....	.....
Cuba	3,762,000	.....	1,712,400
Mifflin	3,902,000	.....	.....
Galena	2,964,000	.....	.....
Hazel Green	2,446,000	.....	.....
Linden	1,984,000	....	.....
Platteville	1,718,000	.....	.....
Shullsburg	832,000	.....	.....
Highland	384,000	.....	.....
Dodgeville	84,000	80,000	.....
Mineral Point	90,000	.....	.....
Potosi	54,000	.....	.....
Total	32,512,000	80,000	1,712,400

The gross turn-in of raw ore for the month exceeded 28,000,000 lb., net refined ores and green concentrates from mine to smelter, and separating plant to smelter for the month 18,250,000 lb. The Mineral Point Zinc Co. delivered 3,390,000 lb. of high-grade separator ore to smelter at DePue, Illinois, which is not included in the table above.

The Mineral Point Public-Service Co. completed its main transmission-line to the extreme north end of the field. Considerable new equipment is being erected at many points.

TEXAS

Copper, Zinc, and Quicksilver Prospects.—Oil.

There is a revival of prospecting in the region east of El Paso, especially north of Allamore and north and north-west of the Van Horn, where considerable copper ore has been extracted and shipped by the prospectors. Last week the Pecos mine, 18 miles north of Van Horn, in the Diablo mountains, shipped four cars containing 26 to 28 tons each, averaging $20 gross in copper.

About five miles north of Kent, a zinc prospect is being opened. It looks pretty good. A small shipment has been made.

The Terlingua quicksilver district is working full time, with good results. Several new quicksilver prospects have been found in the district, and prospecting is active.

Owing to the advance in the price of oil new life has been given the prospecting companies, especially at San Antonio, Taylor, and Strawn.

CRIPPLE CREEK, COLORADO

Prospects at Straun Mountain.—Lessees' Results at the Isabella and Lower Dead Pine.—Vindicator and Portland.

There has been considerable prospecting during the past few months at the south-east end of the district, in the vicinity of Straub mountain. It is reported that two low-grade veins have been opened for a considerable distance in the Maybelle property. It is expected that a company backed by Eastern capital will start more extensive operations during the early part of next year.

Carnduff and Duncan, lessees of the Lower Dead Pine mine on Battle mountain are extracting good ore from the Dorothy vein. These lessees are now working from the 10th level of the Gold Coin shaft. This level is about 200 ft. lower than the bottom of the Lower Dead Pine shaft.

It is understood that A. Pearce and associates have obtained a three years' lease on a large portion of the Prince Albert estate on Beacon hill. New development work on an extensive scale will soon be started on this old-time producer.

The Vindicator Consolidated company claims to have made a new record for production during September, having sent out nearly 5900 tons of ore. An important discovery has been made on No. 18 level of No. 1 shaft, where a cross-cut exposed No. 1 north vein, and proved the extension of the rich ore-shoot developed on No. 16 level. The company has declared a dividend of 3c. per share, equal to $45,000, payable October 25.

The Portland Gold Mining Co. will pay 3c. per share on October 20, amounting to $90,000.

It is reported that during September lessees at the Isabella produced a little over 2000 tons of ore valued at $45,000 gross. The Isabella company is to install new concentrating machinery in its mill. As soon as the necessary changes have been made, a considerable quantity of low-grade ore from the mine and dumps will be treated.

Within a few days the Red Cross hospital at Victor will be transferred to the Portland-Vindicator commission. These companies will make some changes, and the result will be one of the best hospitals in the State. The acquisition of this institution is in keeping with the policies of these two companies, as was announced about August 1 in a circular to their respective employees.

LORDSBURG, NEW MEXICO

Review of Mining in the State: Burro Mountain, Santa Fe, Chino, Eighty-Five, and Waldo Mines.—Steins, Luna County, White Oaks, Pinos Altos, and Mogollon.

Improvements planned by the American Smelting & Refining Co. for its El Paso smelter reflect the state of mining in the South-west. The new equipment will cost over $300,000.

Before the end of the year another large copper producer will enter the field, namely, the Burro Mountain Copper Co. of Tyrone. Mill construction is progressing rapidly, besides company dwelling houses, stores, hospital, etc. The mines are being equipped with electric haulage and hoisting facilities. Over 500 men are on the company's payroll at present.

In northern New Mexico the Santa Fe Gold & Copper Co. is doing well, and is producing over 300,000 lb. of copper matte per month. Reports from San Pedro, where the company operates, state that the profits for the past quarter were $74,130.

Chino continues to yield its usual amount of copper, and it is thought that an extra dividend of $3 per share may be paid. This, as well as all other New Mexico metal mining companies, has not been troubled by the Western Federation of Miners, and it is hoped that such will not happen.

In the local (Lordsburg) mining region there has been little change in the last two months. The Arizona & New Mexico railway spur is completed, and hauling ore from the Eighty-

Five mine. During September 232 cars of copper ore were sent to the El Paso and Douglas smelters, but during October the output will probably be doubled, as the mines were closed at various times owing to break-downs and installation of new machinery, as well as poor railway service, during September. The Eighty-Five Mining Co. has purchased the Atwood mine from the Atwood Copper Co., and has two diamond-drills prospecting on the main vein. The deal is said to have involved the sum of $100,000. The Atwood mine adjoins the Eighty-Five property on the east, and is developed by a two-compartment shaft to a depth of about 400 ft. The mine has been operated spasmodically for the past 20 years and at times has been the largest producer here. The ores are lean as far as development work has gone, and only during a period of high copper prices has the operation of the mine been economical. The Atwood vein is the most prominent, and well defined in the Lordsburg district. With the acquisition of this mine the Eighty-Five now controls practically the best properties in the Virginia district.

The Waldo lead concentrating-plant has been closed down pending mine development work. During the operation of the mill high recovery was made, but, owing to the hardness of the surface ores, crushing was troublesome, and the company will now make an effort to block out a large tonnage in its mines.

Crocker and Randall are shipping regularly from the Nellie Bly mine at Leidendorf, and D. W. Briel is successfully operating the Robert E. Lee mine in the same camp.

Development work still continues at Lee's peak, where the Monte Rico and Octo mining companies hold valuable claims.

At Steins, Creswell and Moffitt are shipping from the Johnnie Bull mine. Their ore is high grade.——W. Charles is shipping lead ore from the Oldem mine to the El Paso smelter.——Mining men from Globe and Miami have been through the Steins field, and have proposed a consolidation of some of the most promising copper properties, and operating them on a large scale.

A new company has been organized at Steeplerock to operate the claims held by George A. Kalar; it is known as the Eclipse Mining & Milling Co.——In the same district George H. Utter is purchasing larger equipment for the operation of the Jim Crow mine.—David Gough has taken a lease and option on the Gold Crown mine near Steeplerock.

Luna county is gradually coming into prominence, and several important transactions have been completed in the last two weeks. The Saddler zinc mine at Cook's Peak has been sold to Holzmeyer and Gunther of El Paso, and will be operated on a substantial scale. Shipments will be made from the new Spaulding station to Oklahoma zinc smelters.——The Azure Mining Co., of Tyrone, has entered the Tres Hermanas district and has taken over the Contention mine. M. L. and J. Doby are doing shaft sinking for the Azure company on contract.——Two new mining companies have been organized at Deming, namely, the American Spelter Co., incorporated by D. S. Robins and J. S. Vaught, and the Royal John Mining Co., with J. C. Watson as agent.

An important transaction is reported from White Oaks, in Lincoln county. It is stated that the North and South Homestake and other producing mines have been taken under option by Richard Wrightman of Chicago. At Jacrilla a gold discovery of importance has been made by William Mehrman.

Activity in the Pinos Altos district of Grant county is increasing. Stauber and Wright are operating a new mill, and employing from 40 to 60 men. They are making high recovery on the base ores, and are treating a large amount of custom ore.——The Tip-Top mine has been leased to Baker and Newman of Central, who have begun development work.——Egbert, Case, and Whidden are operating the Gray and Copper Jack properties under lease, and are driving an adit a distance of 275 ft. They have cross-cut some good veins.——The Hardscrabble mine is under operation now by Janes, Wilcox, and Docker. Good ore has been opened at a depth of 50 ft., averaging 26% copper and 20 oz. silver. The company has shipped 800 tons of ore to date. F. V. Bush, of Lordsburg, has the sale of this property.——A new hoist is being installed by Watkins and Welch east of the Hardscrabble mine.——W. Stevens is operating the Garfield mine with a new hoist, and is getting into good ore.——Doyle & Co. are developing a 14-in. vein in the Manhattan adit, and propose to soon put on a large number of men.——W. H. Mills has leased the property held by him to a Magdalena mining man who is to install a gasoline hoist.——Peterson and Esplane are shipping concentrate from their mill.

The 250-hp. plant of the Empire Zinc Co. at Hanover has been completed. Work is progressing well in the new ore-treatment plant. The power-house is equipped with a Snow-Deisel type oil-engine.——The Monte Cristo mines at Gold Gulch have been sold by Frank Phelps to Frank G. Wilson, of Oregon. His son will have charge of the work.——J. W. Bible is operating the Modoc and other mines at Fierro under lease from the Phelps-Dodge Co. The Katy Mining Co. is doing extensive mining in the same region.——The United States Copper Co. at Hanover is preparing for a resumption of operations.

Conditions remain unchanged in the Mogollon district. Regular shipments of gold and silver bullion are being made from Silver City. It is proposed to have the new bridge over the Gila river completed by March 1916. The El Paso Bridge & Iron Co. received the contract for the erection of the bridge, and has begun work. A passage over the Gila river has been one of the hindrances to progress in the Mogollons, but this will be overcome with the completion of the bridge.

The Memphis & Red River Mining Co. has purchased the mine and mill machinery of the Trinidad Mining Co. at Red River, and is getting same in condition for operation.

GOLDFIELD, NEVADA

New Exploration by the Merger.—Jumbo Extension. Kewanas, Spearhead, Sandstorm-Kendall.

After an examination of its property and adjoining ground by G. H. Garrey, geologist of New York, the Goldfield Merger Mines Co., in charge of Willis Lawrence, has started a new cross-cut at a depth of about 1175 ft. for the purpose of intersecting the ore-channel exposed in the Jumbo Extension mine. The formation is expected to be cut near the west side-line of the Sunflower claim of the Merger. This work will be continued through the Grizzly Bear shaft of the Goldfield Consolidated, but later all operations of the Merger company will be conducted through its own shaft, which is nearly 1800 ft. deep, and equipped with one of the best surface plants in Nevada.

On the deepest level, 1017-ft., of the Jumbo Extension mine, a cross-cut is being driven from the most south-easterly workings to connect with the Velvet or No. 2 shaft, when the latter has reached this depth at the end of the year. The cross-cut is in the shale, but shows ore assaying from $8 to $12 per ton, and is being diverted slightly from its most direct course to follow this ore.

In the Kewanas the drift at 840 ft. in the northern part of the Kewanas claim, has followed the ore-shoot for over 160 ft.: it shows from 18 in. of $80 to 5 ft. of $25 ore.

The Spearhead Gold Mining Co. has decided to proceed at once with development on company account. The first work will be to sink the main shaft 250 ft. deep to reach the shale-contact, at an estimated depth of 1000 ft. Mr. Bruce is superintendent.

A large pump is being installed in the Sandstorm-Kendall to permit driving of the cross-cut from the bottom of the winze at 700 ft. depth.——Development continues at the Silver Pick, Great Bend, and Black Butte.

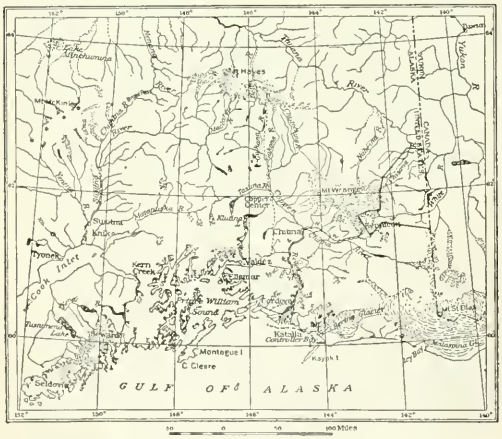
THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

At the United States Assay Offices at Boise, Carson City, Helena, and Salt Lake City, the Government has reduced the charge of $3 for each metal determined in an ore to $1. This will benefit prospectors. Tin and tungsten are to be assayed, but the charge for these will be higher.

ALASKA

Bulletins 622 E, F, G, and I of the U. S. Geological Survey, by B. L. Johnson, Stephen R. Capps, Henry M. Eakin, (2) respectively, deal with certain parts of Alaska. The first covers mining on Prince William Sound and the gold and copper deposits of the Port Valdez district. The lode-mining districts of the Sound may be grouped into two concentric belts, concave southward, the outer one including the gold, and the inner one the copper areas. In 1914 there were eight gold and two copper


Eagle
Mt. Natazhat
Mineral Cr.
Slate Creek
Knik
Bremner
Valdez
Port William
Sound
Montague I.
C. Cleare
Seldovia
GULF OF ALASKA
Kayak I.
Kodiak
Chitina
Copper R.
Nizina R.
Tonsina
Valdez Cr.
Kotsina R.
Bering R.
Katalla
Controller Bay
Yakutat
Dry Bay
Juneau
Skagway
Dyea
Haines
Chilkoot
Chilkat
Klukwan
Porcupine
Pleasant I.
Admiralty I.
Baranof I.
Chichagof I.
Yakobi I.
Kruzof I.
Sitka
Mt. St. Elias
Mt. Logan
Mt. Vancouver
Mt. Fairweather
Mt. Crillon
Mt. Hayes
Mt. Sanford
Mt. Wrangell
Mt. Blackburn
Mt. Drum
Mt. Sumner
Mt. Bona
Mt. Cook
Mt. Churchill
Mt. Natazhat

CALIFORNIA

Bulletin No. 70 of the California State Mining Bureau has just been published. With index and 21 maps it covers 184 pages. The mineral production for 1914 and mining law appendix are the principal sections. New features of the appendix are the inclusion of details of the new department of petroleum and gas, for regulating the drilling of wells; (this has also been published in pocket form with 34 pages), the new corporation license tax law, and sub-heads on assessment work. In the mineral section brief descriptions of the occurrences, characteristics, and uses of many minerals are given. An interesting chapter discusses magnesite. The main chapters are fuels, metals, structural materials, industrial materials, salines, and mineral production by counties. The maps are good. The total value of all products in 1914 was $5,208,086 less than in 1913, due to the general depression. The value was $93,436,553, of which petroleum accounted for slightly over 50%, and gold 22%. County production varied from $300 in Tehama to $28,047,957 in Kern. Details are as follows, in tons except where given otherwise:

Substance.	Quality, tons.	Value.
Asbestos	51	$1,530
Barytes	2,000	3,000
Bituminous rock	66,119	166,618
Borax	62,500	1,483,500
Brick, number	270,791,000	2,288,227
Cement, barrels	5,109,218	6,558,148
Chromite	1,517	9,434
Clay	179,948	167,552
Coal	11,859	28,806
Copper, pounds	30,491,535	4,055,375
Feldspar	3,530	16,565
Fuller's earth	760	5,928
Gems	.....	3,970
Gold	.....	*20,775,000
Gypsum	29,734	78,375
Infusorial earth	12,840	80,350
Iron ore	1,436	5,128
Lead, pounds	4,697,400	183,198
Lime, barrels	439,961	378,663
Limestone	572,272	517,713
Magnesite	11,438	114,380
Manganese	150	1,500
Marble, cubic feet	25,436	48,832
Mineral paint	132	847
Mineral water, gallons	2,443,572	476,169
Natural gas, cubic feet	16,529,963,000	1,049,470
Petroleum, barrels	102,881,907	47,487,109
Platinum, onnces	330	*14,800
Potash	10	460
Pumice stone	50	1,000
Pyrites	79,267	230,058
Quartz	2,500	4,800
Quicksilver, flasks	11,373	557,846
Salt	223,806	583,553
Sand, etc.	26,038	17,888
Sandstone, cubic feet	111,691	45,322
Silver	.....	*814,230
Soapstone	1,000	4,500
Soda	6,522	115,396
Stone, miscellaneous†	.....	4,860,357
Tungsten ore	4,830	180,575
Zinc, pounds	399,641	20,381
Total	.....	$93,436,553

*Estimated.

†Including granite, macadam, rubble, paving blocks, sand, and gravel.

All California miners should get a copy of this publication.

Amador County

San Francisco and Sacramento people have formed the Sutter Creek Mining Co. with a capital of $300,000 to develop the East Eureka mine at Sutter Creek.

Butte County

In the long suit of H. T. James and others *v.* the P. B. Steifer Mining Co. to restrain the company from assessing stock and from selling unpaid assessed stock to pay assessments, the defendant won.

Calaveras County

Development in the Calaveras copper mine at Copperopolis continues most encouraging. On No. 4 level south the hanging wall shows 15 ft. of 34% ore, with streaks assaying 9%. A shipment of concentrate on September 23 averaged 11.12%, and returned $1098 net. There are 106 men employed.

Eldorado County

A great area of buried river gravel deposits exists in this county, but capital is required for its exploitation. Early in November L. A. Bender and C. Wright are to start driving an adit to cut the channel that runs through Newtown ridge at the head of Missouri canyon, three miles west of Pleasant Valley on the road to Diamond Springs.

Nevada County

The new 20-stamp mill at the Brunswick is nearly complete. ——Ten stamps are to be added to the Golden Center mill; a cyanide-plant is being considered.—— Owing to an accident to the motor-driven pump the Central Consolidated mine at Greenhorn was partly flooded last week.——The Ben Franklin and Alaska mines have been bonded to New York people.

The old Yuba mine at Maybert, seven miles above Washington idle for five years, has been purchased by the Dinero Mining & Power Co. of San Francisco. The shaft, 960 ft. below the adit, is to be unwatered, and deepened. W. J. Connors is in charge. The property, formerly controlled by Haggin and Hearst, has produced over $2,000,000.

Placer County

The city of Auburn is defendant in a suit for $20,000 damages, brought by J. Malmberg, who alleges that sewage dumped into the Auburn ravine prevented his mill being worked.

Shasta County

(Special Correspondence.)—The Arps copper mine near Copper City has been taken under bond by C. L. Wilson, who has started work with a small force. The property is near the Bully Hill claims, and has been slightly developed by several short adits and drifts. It is owned by William Arps of Copper City and R. M. Saeltzer and others of Redding.

The Mammoth Copper Co. has completed surveys for the new tramway from the Stowell mine, and construction is about to begin. The line will connect with the Balaklala tramway, near Coram, from which point the ore will be sent direct to the Kennett smelter.

Ore averaging 6% copper is being shipped from the Greenhorn mine, near Tower House. The orebody recently intersected in a lower adit is developing well. Better shipping facilities have been installed at the mine and a larger output will be commenced shortly.

J. P. Erhart, of Ono, has acquired full ownership of the North Bank quartz mine, and is preparing to work the claim more vigorously.

Considerable work is under way at the Telluride Con. group, near Middle Creek. Winter supplies are being shipped in. Anton Herzlieb is managing director.

Equipment for the Gardella dredge on the Saeltzer ranch, about four miles from Redding, is arriving, and excavation of the pond is nearly finished. It is proposed to start operations before the year ends. The old boat of the U. S. Dredging Co. has been moved to the farm of Perry Marks, below Redding. A large deposit of gold-bearing gravel has been prospected, parts of the channel containing 10 to 40c. per cubic yard.

Operations have been curtailed at the Gladstone mine, near French Gulch, and the working force reduced. Prospecting is proceeding from the lower levels, and the shaft is being deepened.

Prospecting of copper claims is active, particularly in the East Side field, where several properties in the vicinity of Copper City and Herault are commanding attention.

Gold mining is rather quiet, with the exception of increasing activities on the part of dredging concerns.

Redding, September 27.

SISKIYOU COUNTY

One of the largest mining deals that has been completed in this county for years was that when M. E. Olsen and others of Seattle bought the six claims of H. B. Wintering and F. H. Osgood on south Russian creek, Salmon river district, for $85,000. The Big Cliff Mining Co. has been organized to develop the property. A large quantity of medium-grade ore has been opened, and a 200-ton mill is to be planned.

The Klamath River Dredging Co.'s new boat will soon be finished. It has been designed to handle the large boulders met with in the Klamath river.

COLORADO

CLEAR CREEK COUNTY

During September the Chamberlain-Dillingham sampler at Georgetown shipped 400 tons of ore and concentrate worth $35 per ton. This works does not handle all of the products of the district. Zinc ore was not shipped, and is being stored at the various mines and mills.——Developments in the Mineral Chief are encouraging.——Lessees at the Waldorf are shipping good ore.——The Edison process is working at the Silver Plume Reduction Co.'s mill, and a good recovery is being made.

GILPIN COUNTY

Pennsylvania steel people have purchased for $16,000 the Rogers upper tract of 160 acres of tungsten-bearing claims in the Nederland district. The property has been a large producer.

LAKE COUNTY (LEADVILLE)

Most of the large stopes at the Penrose shaft of the Down Town property are drained.——The St. Louis adit in Big Evans gulch is the largest producer of high-grade gold ore in the district. Zinc sulphide is being developed also. This ore is being treated at the Leadville District mill.——At the Fortune mine the old shaft has been re-timbered to 1000 ft. depth. A new hoist has been installed. Zinc carbonate is to be extracted from the 600-ft. level. James McNeece is in charge.——The Mt. Champion in Lackawanna gulch is producing up to 150 tons of ore per day, the mill treating 100 tons. A new electrically-driven compressor is at work.——Prospects at the Jennie June mine are good, and good gold ore is to be shipped.

IDAHO

SHOSHONE COUNTY (COEUR D'ALENE)

Although water has hindered work at the Marsh mine at Burke, development and mining proceeds satisfactorily. A new pump is to be installed. At 900-ft. a station 50 ft. long, 25 ft. wide, and 20 ft. high is being cut out. It will serve for pumping and storage of ore, etc. The new Nordberg hoist, of 2700-ft. capacity, is working well. The mill, near Wallace, has been overhauled, and treats 150 tons daily. A Callow flotation plant is operating. Since the improvements were made the recovery is $1.25 per ton better. The company employs 90 men in charge of W. E. Greenough.

On October 25 the Success company, Nine-Mile district, will distribute 6c. per share, equal to $90,000. The current year's total is $495,000. Lead-silver, then zinc, and again lead ores have been the products of this mine.

At the Independence Lead Mines Co.'s mine near Mullan, the No. 4 adit, now in 1000 ft., is to be extended 230 ft. to cut have been the products of this mine.

Development of and shipments of antimony ore from Coeur d'Alene mines continues, and is likely to become very important in this region.

MICHIGAN

THE COPPER COUNTRY

According to *The Daily Mining Gazette* the estimated output for September was as follows:

Mine.	Pounds.	Mine.	Pounds.
Tamarack	561,000	Hancock	159,000
Osceola	1,725,000	LaSalle	177,000
Ahmeek	2,225,000	South Lake	21,600
Wolverine	711,000	Isle Royale	900,000
Mohawk	1,359,000	Copper Range	4,600,000
Franklin	381,600	Quincy	2,000,000
Centennial	53,000	Calumet & Hecla	6,500,000
Allouez	848,000	White Pine	491,000
Mass	486,000	Lake	280,000
Superior	326,000	Winona	230,000

Shipments of mineral from the White Pine mill to the Calumet & Hecla smelter at Hubbell are made by water; but early in November transport will be by rail, as the C. & H. has let a contract for construction of two miles of track to connect the White Pine with the Chicago, Milwaukee & St. Paul road.

The Quincy is producing over 4000 tons of ore per day from three shafts. This will be increased when No. 7 shaft is complete. The eight stamps have a daily capacity of 5500 tons. The Hancock contributes 650 tons per day.

MONTANA

SILVERBOW COUNTY

Pumping has been started at the Emma zinc mine of the Anaconda company.

The North Butte mine is at normal production again, the daily output being 1350 tons of ore. An important development is reported on the lower level of the Jessie vein.

Wages at Butte in September amounted to $1,500,000, the Anaconda distributing $1,090,000, Butte and Superior, $170,000, and North Butte, $100,000.

NEVADA

CLARK COUNTY

The high price of zinc is having its effect on the Good Springs district.——The Yellow Pine company is shipping 1500 tons of zinc ore, and 200 tons of lead concentrate per month. A dividend of 10c. per share was paid on September 25. This is equal to $100,000, making $230,000 for the current year. The main shaft is 900 ft. deep.——The Empire Zinc Co.'s Potosi mine is producing 900 tons of zinc ore per month.——Ore-bins and a sorting-plant have been erected at the Green Monster mine. The monthly output of carbonate ore is 500 tons. Several adjoining properties are doing interesting work.——At the Bullion mine a 50-ton dry concentrating-plant is treating low-grade lead ore. A similar plant is being erected on the Anchor, and one has been ordered for the Sultan. There are six plants in operation or under construction in the district. ——Boston people have acquired the Doran and Zenzen mine on Pig Devil mountain.——A number of other mines are being worked by owners and lessees.

ELKO COUNTY

Jarbidge is busy and optimistic. The Bluster property is producing $10,000 gold per week.

LINCOLN COUNTY

The Prince Consolidated mine is now shipping ore at the rate of 12,000 tons per month. The cost of mining and loading on cars is $1.20 per ton. The three-compartment winze below 550 ft. is down 125 ft. Eventually it will act as a main shaft, as it is to be raised to the surface.

Nye County

Five companies and numerous lessees at Tonopah last week produced 9583 tons of ore worth $198,454. The Belmont, Extension, and Tonopah dispatched a total of $223,000 of silver. The earthquake, on October 2, which was felt in the mines of the district, caused considerable alarm, but did no damage.——Results at 1350 ft. in the Extension are excellent, there being 20 ft. of good ore at the end of west drift 502.——In the Rescue-Eula, the winze sunk on the vein below the 950-ft. level, is down over 40 ft., showing 12 in. of good ore.——In the Umatilla-Tonopah the diamond-drill is down 450 ft. below the 1200-ft. level. The country is mineralized, and is less broken than previously.

White Pine County

(Special Correspondence.)—The additional power-plant at the Nevada Consolidated is now working well. An increased output should result at the mill.

There is much activity in the eastern part of the county in tungsten mining. Probably 100 men are working while others are prospecting for new veins. A 65% product is said to realize $2000 per ton, whether scheelite, wolframite, or hübnerite.

The old Victoria copper mine, 15 miles north-east of Currie, in the south-west corner of Elko county, is being worked under a bond and lease by Seattle people.. It is said they are ready to commence shipments of 8 to 9% ore.

The Willow Creek Con. property, about 100 miles south-west of Ely, which has been taken over by Salt Lake people, is said to be developing satisfactorily. Some of the ore shows free gold.

Ely, October 7.

OREGON

Baker County

Shipments of ore and concentrates from Sumpter during the current month are expected to be large.——No. 2 boat of the Powder River Dredging Co. is nearly ready for work. It has 7.5 cu. ft. buckets, and was built by the Yuba Construction Company.

SOUTH DAKOTA

Pennington County

A tungsten property four miles east of Hill City has been sold by A. Wabel to the Chicago Steel & Iron Co. for $125,000. Prospecting and developing tungsten claims is fairly brisk in this district.

TEXAS

Culberson County

(Special Correspondence.)—A large deposit of sulphur has been discovered by W. A. Doyle of Dallas, 45 miles north-west of Riverton, near the New Mexico state boundary, and 18 miles from the Pecos Valley line of the Santa Fe railroad. A spur line will probably be laid down to the deposit. Mining will be simple, as the mineral occurs at a depth of 12 feet.

Riverton, October 1.

UTAH

Beaver County

The South Utah Mines & Smelters, successor to the Newhouse Mines & Smelter Co., resumed work on October 1. The property was closed in June 1914, after producing a good deal of copper. The mine is opened to 600 ft. by two shafts, connected by a 6300-ft. electric haulage-way. Ore assaying 1.8% copper has been opened at 600 ft. A 1000-ton mill is part of the plant.

In the Croff mine, Lincoln district, 3 ft. of carbonate of zinc ore has been cut, also 3 ft. of lead ore, but quite separate.

Juab County

Shipments from Tintic mines last week totaled 134 cars. At a depth of 300 ft. below the 600-ft. level in the Iron Blossom 10% copper ore has been cut. This is under a shoot which has produced ore for some years.——Extraction of $12 to $15 ore in the Dragon Con. near the Iron Blossom has been stopped until the Tintic Milling Co.'s plant is completed.——Lessees at the Yankee Con. are shipping rich zinc ore.

Salt Lake County

The output of the Alta-Cottonwoods district this year is expected to be over 120,000 tons of ore, a large increase over that of 1914. The Cardiff, Emma, Michigan-Utah, and South Hecla are the largest shippers. In the last named the ore-body at 225 ft. depth is 155 ft. long and up to 20 ft. in width. Eight raises are in ore.

The Michigan-Utah is to extend its adit, which is in 200 ft., to cut the City Rocks vein at a depth of 550 ft. The mine is producing a good tonnage of ore.

Summit County

A total of 9176 tons of ore was shipped from the Park City district in September, of which 2829 tons was from the Daly-Judge mine, 651 from the Daly West, 353 from the Silver King Coalition, and 1364 from the Silver King Consolidated.

The Snake Creek tunnel was advanced 345 ft. during September, and is now in 12,710 ft. in diorite. The vertical depth is 3730 ft. So far the opening has been straight, but it is now headed north-west for the Daly-Judge property, 2000 ft. away. The flow of water is 7947 gal. per minute. Additions are being made to the Daly-Judge mill. Good ore has been cut at 1200 feet.

Tooele County

Alleging that their live-stock and crops have been damaged by fume, and that agreements as to land purchases were not kept up, 26 farmers and their wives are suing the International Smelting & Refining Co. for $265,337 damages, and $39,781 for attorneys' fees, a total of $305,118.

The Ophir district is producing more ore than ever before. In August 131 cars of ore and concentrate were sent out. The Ophir Hill Consolidated has 11,000 tons of concentrate stored at the mill, shipping only enough to abide by its contract. Rich silver-gold-zinc ore is being extracted from the St. Clair lease on Lion hill, the yield since May being over $30,000. Leasing is employing 150 men.

WASHINGTON

Ferry County

At the Knob Hill mine at Republic there are 17 men employed and the monthly output of gold ore is about 350 tons. This goes to the Trail smelter. A shoot 300 ft. long, with 18 in. of profitable ore, has been opened on the intermediate level. In the lower adit this shoot is 150 ft. long. When electric power is available a shaft will be sunk to develop the property at depth.

CANADA

British Columbia

At the end of last week representative mining and business men of Spokane visited the Kootenai mining district.

At the south-eastern end of Moresby island, one of the Queen Charlotte group, 400 miles from Vancouver, the Ikeda Mines Limited is developing and extracting copper ore. The property was located nine years ago by A. Ikeda, one of the directors. In 22 months a net return of $58,823 was received from 5915 tons of ore. Development is done by adits. Suitable surface plant has been erected. The mine has been favorably reported on by engineers. At present 30 men are employed, and 50 tons of ore is shipped each month to the Granby smelter at Anyox. Two settlements in September showed the ore to assay up to 17% copper, 3.5 oz. silver, and 0.33 oz. gold. More men are to be employed and larger shipments made. This island is said to be well mineralized and worth prospecting. Heavy timber is growing, there is water-power, and plenty of game. Steamers call twice a month.

ONTARIO

When the 13 by 30-in. Buchanan crusher, 6 ft. by 16-in. ball-mill, 5 by 16-ft. tube-mill, five 32 by 10-ft. thickeners, and three 32 by 18-ft. agitators are installed at the McIntyre mill, the whole plant will have a daily capacity of 450 tons.

Diamond-drill prospecting is under way at the Old Huronia mine at Gauthier township.

In *The Canadian Mining Journal* for October 1 are two illustrated articles dealing with the Kowkash goldfield. An abstract of one has already appeared in the PRESS; in the other, by C. Spearman, he considers the area as promising for exploration. In many places the geological conditions strongly resemble the Porcupine district.

MEXICO

EL ORO

The Esperanza Mining Co. reports as follows for the period from April 1 to June 30: Development amounted to 1652 ft. on the first, second, and third levels of the Descubridora vein,

VENUSTIANO CARRANZA, DE FACTO PRESIDENT OF MEXICO.

raises above No. 3, 5, and 9 levels, and work on No. 14 and 15 levels of the San Rafael vein. Raise No. 3 above No. 2 level on the Descubridora was up 86 ft. in 60 in. of 2-oz. gold and 5.5-oz. silver ore.

'Coal Mining in Mexico' is the title of a paper by T. O. Forster Brown read before the North of England Institute of Mining and Mechanical Engineers. It consists of 42 pages, with illustrations and plans. Nearly all coal mining in the republic is done in the state of Coahuila, 100 miles from the international boundary. In 1912 there were three American, three British, and three Mexican colliery companies. In 1911, when affairs were normal, the output was 1,858,996 metric tons. The approximate consumption of coal in the country was 1,955,128 tons. Imports amounted to 846,981 tons. The revolution resulted in immense damage to the surface plants, as is testified by photographs.

To further help the work of Carranza in restoring order in Mexico, the U. S. government has placed an embargo on the shipment of anything that might be used by the Villa party in fighting; one lot has been held up.

PERSONAL

D'ARCY WEATHERBE is at Cobalt.

J. PARKE CHANNING is at Miami.

E. M. HAMILTON is at Virginia City.

FRANK H. PROBERT is at Salt Lake City.

ALGERNON DEL MAR is at Nelson, Nevada.

H. S. LEE has moved from Oregon to Haileybury, Ontario.

J. D. ROBERSTON, of Robert W. Hunt & Co., is here from St. Louis.

CLARENCE WOODS has returned from Alaska to Tuolumne, California.

ROBERT N. BELL, Inspector of Mines for Idaho, is at the Palace Hotel.

P. B. MOSSMAN of the American Refractory Co. has been here from Chicago.

CLAUDE FERGUSON has gone to Cherry, Arizona, to take charge of the Logan mine.

DIBRELL P. HYNES, who is with H. L. Hollis, of Chicago, is visiting the Exposition here.

PERCY MARMION has been appointed manager of the Swansea Vale smelter in South Wales.

SAMUEL S. ARENTZ passed through San Francisco on his way from Salt Lake City to Imperial, Arizona.

F. E. MARCY has resigned from the Mine & Smelter Supply Co. to engage in business on his own account.

BEN B. LAWRENCE, after a visit to Cornucopia, in Oregon, and Bingham, in Utah, has returned to New York.

BENJAMIN MAGNUS, lately manager of the Mount Morgan mine Queensland, has arrived here from Australia.

WASATU KONDO and M. YAMASHITA have arrived from Japan on a metallurgical reconnaissance in the United States.

G. R. LEWIS of Cripple Creek has been appointed general manager of the Copeland Sampling Co., succeeding W. F. VAN SANT.

J. H. MACKENZIE was on the *Mariposa* when she was wrecked off the British Columbian coast on October 1, without the loss of any passenger.

J. H. CURLE, who volunteered for military service early in the War, has been detached for special work with the Parliamentary Savings Committee in London.

THEO. P. HAUGHEY, accompanied by EDGAR N. FRIEND, both of the American-Oriental Engineering & Construction Co., sailed from Seattle early in October for Yokohama.

W. D. BURCHAM has left Shafter, where he was mill-superintendent for the Presidio Mining Co., in order to take charge of the re-opening of the Big Bend cinnabar mine in Terlingua district, Texas.

HUNTINGTON MILLER, manager of Lo Increible Mining Co., Venezuela, has recently returned from a visit to New York and is again in charge of operations at the company's mines, near El Callao, Yuruary district, Venezuela.

Schools and Societies

Members of the Utah chapter of the A. I. M. E. held their first annual meeting and banquet at the Hotel Utah, Salt Lake City, on October 4. During the evening C. W. Whitley, general manager of the American Smelting & Refining Co., was elected chairman of the local branch, Walter Fitch was elected vice-chairman, and Ernest Gayford, secretary and treasurer. Following the banquet, papers were read by J. M. Callow on the present state of the flotation process, and T. S. Carnahan on underground methods at the Utah Copper. Moving pictures were then shown of mining at Bingham, and milling plants at Garfield, and other works in the West.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, October 14.

Antimony	32
Electrolytic copper	19
Pig lead	4.75—5.70
Quicksilver (per flask)	$92
Spelter	16
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	26

ORE PRICES

Antimony: market weaker, 50% product, free from deleterious impurities, per unit.....$1.50

Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....30.00

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, October 14.—Copper is quiet, with no change; lead is steady at the same price; spelter is weak.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct. 7	49.62	Sept. 1	46.77
" 8	49.62	" 8	48.20
" 9	49.50	" 15	48.56
" 10 Sunday		" 22	48.85
" 11	49.50	" 29	49.29
" 12 Holiday		Oct. 6	49.64
" 13	49.50	" 13	49.55

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	48.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The above quotations indicate a steady market. Silver coinage executed in the United States in September was worth $717,000, using, say, 1,500,000 oz. Last week the Nipissing company sent 250,790 oz. to England via New York. Exports of silver from London to the Orient to September 22 were worth £3,376,250, against £4,520,500 in that period of 1914, a decrease of, say, 12,000,000 oz. Rains in India have been favorable.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Oct. 7	18.00	Sept. 1	17.83
" 8	18.00	" 8	17.62
" 9	18.00	" 15	17.42
" 10 Sunday		" 22	17.75
" 11	18.00	" 29	17.87
" 12 Holiday		Oct. 6	18.00
" 13	18.00	" 13	18.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports of copper during the week ended September 25 amounted to 8,273,626 lb., valued at $1,568,448. France took 5,257,786 of this; England, 1,368,899; and Italy, 1,273,266 lb. Imports totaled 6,795,778 lb., worth $845,454. Peru contributed 2,538,827 and Chile 1,378,919 pounds.

Some September outputs were as follows: Anaconda, 22,800,000; Kennecott, 9,000,000; Greene-Cananea, 3,514,000, an increase of 600,000; Old Dominion, 2,538,000; and East Butte, 2,089,820 pounds.

Miami will pay $1 per share on November 15. An extra dividend is expected from the Ray. Greene-Cananea is expected to declare a dividend soon. Chino's earnings are at the rate of over $9 per share.

Michigan producers think that the Anglo-French loan will stimulate the copper business. Accumulations at Michigan smelters and docks amount to about 30,000,000 lb. This is not considered unusual at this time. Fully one-third is said to be sold.

ALUMINUM

The quotations continue to soar and 50c., New York, has been paid, while up to 52c. has been asked. In fact, fancy premiums have been offered and in some cases without inducing a sale.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Oct. 7	14.00	Sept. 1	15.75
" 8	13.75	" 8	14.77
" 9	13.50	" 15	13.92
" 10 Sunday		" 22	13.58
" 11	13.25	" 29	14.23
" 12 Holiday		Oct. 6	14.37
" 13	13.25	" 13	13.55

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The demand for zinc ores in the Missouri-Kansas-Oklahoma region was very strong last week, prices for 60% product being up to $87.50 per ton. The output was 6169 tons blende, 188 tons calamine, and 993 tons lead, averaging $77.03, $55, and $51 per ton respectively. The total value was $546,148, and 41 weeks, $18,372,936.

In September the Butte & Superior produced 13,000,000 lb. zinc, a decrease due to 4 days' shut-down.

The Consolidated Interstate-Callahan's report for the year ended June 30, 1915, shows a profit of $1,591,773. The monthly output of concentrate is 6000 tons.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Date.		Sept. 29	90.00
Sept. 15	90.00	Oct. 6	90.00
" 22	90.00	" 13	92.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

The local market is strong.

New York is quoting $92 per flask.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct. 7	4.50	Sept. 1	4.87
" 8	4.50	" 8	4.90
" 9	4.50	" 15	4.63
" 10 Sunday		" 22	4.50
" 11	4.50	" 29	4.50
" 12 Holiday		Oct. 6	4.50
" 13	4.50	" 13	4.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.35	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.53	Oct.	30.10	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin was quoted on October 13 at 32.50 to 32.75 cents.

ANTIMONY

There is plenty of antimony to be had but the demand is quiet, and Chinese and Japanese metal is to be had easily at 28 to 28.25c., duty paid. Domestic antimony is offered at ¼c. less. To treat antimony ore from Alaska, Idaho, and Canada, a smelter is being erected at Seattle.

Eastern Metal Market

New York, October 8.

Some further large sales of copper have been made to manufacturers of munitions, but the trade in general has been quiet. An interesting development is the growing use of electrolytic where Lake had been regarded as indispensable. Prices have been maintained, despite a tendency to soften. The London market for electrolytic holds firm. Spot and near-by zinc continues scarce, and business has been restricted to flurries of small-lot buying. Lead has been dull, though quotations are steady at the level fixed by the leading interest. London has been more active than New York on account of selling to Russia. Tin declined in a dull market to 32c., but jumped to 33c. on October 6. Antimony is quiet and in plentiful supply. Aluminum is scarcer than ever and 50c. per pound and upward is quoted. Buying of all the metals has been in flurries, and more or less irregularity is shown in all directions.

Iron and steel have continued their amazing pace. In September the pig-iron production was 2,852,561 tons, or 95,085 tons per day. The previous high record was 92,369 tons per day, in February 1913. At the present rate of production the figures for this month will be even higher. It is probable that the production of both pig-iron and steel ingots will exceed 3,000,000 tons this month. Not only are the railroads more of a factor in the steel market, but improvement is seen in many directions not associated with war business.

COPPER

Since the heavy buying referred to a week ago there has been a lull in the market, though a few good deals have been reported this week, and some large inquiries are known to be existent. An ammunition maker took 1,000,000 lb. of Lake on October 5, at 18c., cash. All business of notable size continues to be with those having war orders. The fact that the activity has been shared only by the larger sellers has fostered an impression that the magnitude of the sales has been exaggerated, but nevertheless they have been made. The smaller producers and second-hands have not been doing much, and as a result they have become more and more inclined to give concessions in price, although 18c. cash, New York, is still the general quotation for both Lake and electrolytic. An old-timer in the metal market does not think, when circumstances are considered, it peculiar that Lake and electrolytic are quoted at the same level. First, he points out that Lake is usually sold for cash, and electrolytic, cash, 30 days, the latter terms being more to the advantage of the buyer; second, there is no difficulty at any time of obtaining electrolytic in any quantity, while the recent past saw a scarcity of prime brands, and with the scarcity large premiums were demanded. In the judgment of many, these premiums were exorbitant. A third point in the argument is that since the outbreak of the War, and even prior thereto, consumers have found that they can use electrolytic where they previously had supposed that Lake was indispensable. Because of its greater penetrability, Lake always has been used in the manufacture of high-grade cartridges, and will continue to be used where maximum quality is required. At the same time according to the student referred to, where millions of cartridges are to be used, largely in rapid-fire guns, some slight departure from the highest standards is reasonable to expect. It is notable in this connection that discussion at a meeting of the American Institute of Metals at Atlantic City, last week, brought out that 90% of the members present who formerly had used Lake copper had turned their attention to electrolytic, and that few of them would return to Lake if they had to pay a high premium for it. The London market for electrolytic continues steady at around £88, but standard is variable, and on October 5 was £17 under electrolytic. The exports in the first seven days of October totaled 4624 tons. The European stocks of copper were estimated September 30 at 23,628 tons, against 11,600 tons on the 15th, and 29,519 tons August 31.

ZINC

Spot and near-by metal is scarce, though the absence of any sustained business has caused prices to become a little easier in the past week. On October 4, 5, and 6, sellers would accept 14c., St. Louis, and 14.25c., New York; November can be done at 13.50c., St. Louis, and December at 13c., St. Louis. But little interest is taken in futures by consumers, and what business there has been in prompt has been in flurries involving no large tonnages. London quoted £69 on October 6. In the course of a few days London advanced £5, but even at £69 the foreign market is not on a parity with New York, when costs of import are considered. The rise abroad, of course, is a stimulating feature. The exports in the first seven days of October aggregated 1755 tons.

Sheet zinc is unchanged at 16c. base, f.o.b. smelter, subject to a discount of 8%, for cash and carload lots, and correspondingly smaller discounts for smaller quantities.

Following is a comparative statement of exports of spelter and zinc ores for seven months of this year as per official returns, in long tons:

	Spelter.		Zinc ores.	
	1915.	1914.	1915.	1914.
July	5,340	140	none	1,319
Previously reported ...	57,471	690	605	7,180
Total for 7 months....	62,811	830	605	8,499

LEAD

The market has been dull, but prices have been well sustained, the A. S. & R. Co. continuing to quote 4.50c., New York. London has been more active than New York, largely because of buying for shipment to Russia by way of Archangel before the close of navigation. Following this demand, when a high point of £25 2s.6d. was reached (October 1), London eased off again, and was quoted on October 6 at £23 7s.6d. The New York quotations followed the trend at London both ways. The lead market in general is regarded as in a sound condition, and despite the recent quiet, the wonder is that the leading interest has not advanced its prices. The exports in the first seven days of October totaled 340 tons.

TIN

Except for occasional spurts of buying, the tin maket has been extremely dull, and the tendency of prices has been downward. On October 4 and 5 business was done at 32c., or a shade lower. On October 6 London advanced £3 and the New York quotation went up 1c. Early this week the trade was greatly concerned, and prices were stiffened by a rumor that Great Britain was contemplating the imposition of a 10% export duty, similar to the 2½% duty it recently placed without warning on rubber. London was immediately cabled for information, but the replies received disclaimed all knowledge of the rumored duty. Such a tax, of course, would be paid by the consumer. The statistics for September showed that the total visible supply on September 30 was 15,191 tons, against 15,127 tons, August 30, and 14,613 tons, September 30, 1914. The deliveries and stocks were mentioned last week. Arrivals at Pacific ports destined for the East in September amounted to 500 tons. The total deliveries this year aggregated 35,675 tons, which is 2175 tons over those of the same period last year. There was afloat October 7, 5235 tons.

BOOK REVIEWS

Practical Geology and Mineralogy. Revised edition. By W. D. Hammon. P. 253. Ill., index. The Way Press, South Pasadena, California 1915. For sale by the Mining and Scientific Press. Price, $2.50.

This work, which is in its second edition, is suitable for students in geology and mineralogy, being somewhat elementary in form. The fundamentals of geology, petrology, mineralogy, and mineral deposits are described in simple language, accompanied by illustrations.

The Mining World Index of Current Literature. First half of 1915. By Geo. E. Sisley. P. 208, with authors' and subject indexes. Mining World Co., Chicago, 1915. For sale by the Mining and Scientific Press. Price, $2.

This publication is so regular and arranged on similar lines to previous editions, that there is nothing new to be said about it. As a reference book on technical articles published throughout the world it will be found valuable to editors, libraries, mining and metallurgical firms, and to those who find it necessary to consult the varied subjects discussed.

Surveying Manual. By William D. Pence and Milo S. Ketchum. P. 384. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.

This is the fourth edition of this useful manual. The book has been thoroughly revised and considerable new matter included. The general object of surveying, the use of instruments, methods, etc., occupies most of the volume. Public-land surveying and the retracement of old lines is then discussed. The next chapter treats very briefly of railroad surveying, circular railroad curves being merely mentioned and spirals not even that. It is evident, however, that the authors expected some other text-book to be used for this branch of the work. Other chapters treat of probable error, methods of computing, and topographic drawing. The usual mathematical tables are included. This edition, as well as those that have preceded it, will be of great value as a student's text-book, and to some engineers as a reference pocket-book as well.

Conservation of Water by Storage. By George F. Swain. P. 369. Ill., index. Yale University Press, New Haven, Connecticut. For sale by *Mining and Scientific Press*, San Francisco. Price, $3.

This volume is based on lectures delivered before the Sheffield Scientific School. The first chapter deals with the well-known but generally disregarded facts concerning waste and conservation of natural resources. After pointing out that while there is little or no absolute loss in allowing most natural resources to remain unused for a time, undeveloped water-power, on the other hand, is a total loss for the time being, the author discusses the laws relating to the use of water, particularly water for power-purposes. The doctrine of riparian rights and its modified application in many States is considered. The regulations of the Federal Government regarding water-power development at Government dams, at private dams, and on the public domain are discussed. The author holds that while the imposition of a tax on the private power-companies on the basis of power developed may be inadvisable, still such provisions have been but a slight hindrance to development as compared with the uncertainty of tenure for all projects dependent on the Federal Government for approval. The chapter on Technical Aspects of Conservation by Storage deals mainly with run-off data and with the construction of dams. Two chapters are devoted to Forests and Stream-Flow and to Floods and general means for their prevention or mitigation. The appendix contains several legal documents pertaining to the question of water-power development and a bibliography.

RECENT PUBLICATIONS

U. S. Geological Survey, Washington, D. C., 1915:

Tin Mining in Alaska. By Henry M. Eakin. Bulletin 622-B. P. 14. Maps.

Production of Bauxite and Aluminum in 1914. By W. C. Phalen. P. 27.

Production of Borax in 1914. By Charles G. Yale and Hoyt S. Gale. P. 16.

Production of Salt, Bromine, and Calcium Chloride in 1914. By W. C. Phalen. P. 16.

Mining in the Juneau Region, Alaska. By Henry M. Eakin. Bulletin 622-C. P. 8.

Some Cinnabar Deposits in Western Nevada. By Adolph Knopf. Bulletin 620-D. P. 10.

Gold Deposits near Quartzite, Arizona. By Edward L. Jones, Jr. Bulletin 620-C. P. 13. Map.

A Reconnaissance in Palo Pinto County, Texas. By Carroll H. Wegemann. Bulletin 621-E. P. 9. Illustrated.

Mining in the Fairbanks and Hot Springs Districts, Alaska. Papers by Henry M. Eakin. Bulletin 622-G. P. 17.

Mineral Resources of the Chisana-White River District, Alaska. By Stephen R. Capps. Bulletin 622-F. P. 39. Map.

Gold, Silver Copper, and Lead in South Dakota and Wyoming in 1914. Mines report. By Charles W. Henderson. P. 16.

Possibilities of Oil in the Porcupine Dome, Rosebud County, Montana. By C. F. Bowen. Bulletin 621-F. P. 10. Maps.

The Healdton Oil Field, Carter County, Oklahoma. By C. H. Wegemann and K. C. Heald. Bulletin 621-B. P. 30. Ill., maps, charts.

Iron-Ore Deposits Near Nome, and Placer Mining in Seward Peninsula, Alaska. Papers by Henry M. Eakin. Bulletin 622-I. P. 13.

The Fractional Precipitation of Some Ore-Forming Compounds at Moderate Temperatures. By Roger C. Wells. Bulletin 609. P. 46. Illustrated.

Mining on Prince William Sound, and the Gold and Copper Deposits of the Port Valdez District, Alaska. By B. L. Johnson. Bulletin 622-E. P. 58. Maps.

Equipment for Current-Meter Gaging Stations. By G. J. Lyon. *Water-Supply Paper* 371. P. 64. Ill., plans, index. This is a valuable work for hydraulic engineers.

Relation of the Cretaceous Formations to the Rocky Mountains in Colorado and New Mexico. By Willis T. Lee. *Professional Paper* 95-C. P. 32. Illustrated.

Guidebook of the Western United States. Part A. The Northern Pacific Route, with a side trip to Yellowstone Park. By Marius R. Campbell and others. Bulletin 611. P. 212. Ill., maps, index. Part C. The Santa Fe Route. With a side trip to the Grand Canyon of the Colorado. By N. H. Darton and others. Bulletin 613. P. 194. Ill., maps, index.

The Mexican Oil Fields. By L. G. Huntley. P. 41. Illustrated. Reprint from *Transactions* of the American Institute of Mining Engineers. An abstract will appear in another issue of the Press.

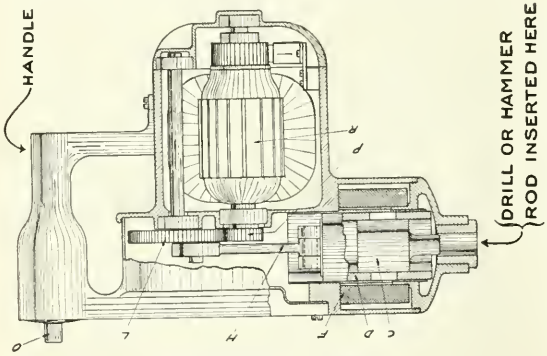
Radium in the Light of Recent Discovery. By Paul Börnsen. P. 36. Published by the author, 301 Tennessee avenue N.E., Washington, D. C., 1915. A presentation of new facts and problems.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Operation of the Western Electric Hammer

The principle on which this hammer works is as simple as it is clever and effective. The principal parts are a motor, a drill or hammer, and a magnetic clutch-plunger interposed between the two. Connected to the motor *R*, through hardened gears *P-L* and connecting rod *H*, there is a cylindrical sleeve *D*, having two relatively thick end sections joined together by a thin centre section. This latter is as thin as is consistent with mechanical strength. The plunger *C*, which delivers the blow to the drill, lies loosely within this cylinder,



THE NEW ELECTRIC HAMMER.

and is not mechanically connected to any part of the mechanism. Outside of the sleeve is the magnet-coil *F*. This is stationary, the sleeve moving back and forth within it. The coil is in series with the motor and the current in it is always in the same direction and steady. As soon as the circuit is switched on, which is done by a button *O*, conveniently arranged on the handle, the solenoid creates a magnetic circuit, with the thick sections of the sleeve as the poles and the plunger as the armature. As the sleeve is moved back and forth by the motor the effect is that of moving the pole-faces of the magnet back and forth, and the plunger clutched across the poles moves with it, transferring its energy to the drill when it meets it, which it does near the end of the stroke. The plunger is slightly longer than the thin section of the sleeve, which gives it a certain amount of over-travel and an elasticity of connection, which entirely removes the strain and jar of the blow from the machine. The motor is series wound, and the gears are of oil-hardened special gear-steel. Ball-bearings are used throughout.

Commercial Paragraphs

The Krogh Manufacturing Co., of San Francisco, recently sold 40 centrifugal pumps to the Anaconda Copper Mining Co., Montana.

The Fall number of the *Yuba Bulletin*, published by the Yuba Construction Co., Marysville, California, contains notes on the Yuba ball-tread tractor and Yuba dredges.

The Burd High Compression Ring Co. of Rockford, Illinois, announces the appointment of Robert Allan, as district branch manager for Northern California. Mr. Allan was formerly attached to the Dallas, Texas, office. His headquarters will be at San Francisco, where he has taken offices and will carry a complete stock, at 847 Phelan building.

W. E. Hardy, for the past eleven years connected with the Diamond Rubber Co., and the B. F. Goodrich Co., and lately in charge of the sales of its mechanical rubber goods division, has recently been apointed sales manager of the Boston Belting Co., Boston, Massachusetts, manufacturers of mechanical rubber goods.

On October 1 the property and business of E. I. du Pont de Nemours Powder Co., of New Jersey, was sold and transferred to E. J. du Pont de Nemours & Co., of Delaware, a corporation organized for the purpose of taking over and carrying on the business. Capital stock amounting to $120,000,000 will be issued. The new name is the same as the original, established in 1802. Chemicals are made as well as explosives.

The Lunkenheimer Co.'s exhibits at the Expositions at San Francisco and San Diego have been described in the Press. The firm reports that the jury of awards was impressed with the quality of the engineering appliances displayed and granted the medal of honor at the Panama-Pacific Exposition, and the grand prize at the Panama-California Exposition. The company has its executive offices and factories in Cincinnati, Ohio, and maintains numerous branch offices and selling agencies throughout the United States and foreign countries.

On February 15, 1906, the California Hawaiian Sugar Refining Co. installed a 36-in. 7-ply Goodrich conveyor-belt. Since then it has caught and carried 2,000,000,000 lb. of sugar that had dropped four feet in 125-lb. lumps, before any radical wear was noticeable. In August 1915 the B. F. Goodrich Co. received an order for another belt. It is 1443 ft. long, 36 in. wide, and weighs 11,983 lb. This belt will receive similar severe working strains as the first one.

The Bucyrus Company announces the appointment of the Union Construction Co., San Francisco, as its agents for the sale of placer dredges for use in Western United States, Western Canada, and Alaska. The Bucyrus Co. states that it has supplied more placer dredges than any other manufacturer, and the Union Construction Co. has had wide experience in the building of hulls and in the erection of such machines in the United States, Alaska, and foreign countries. Estimates will be given for machines of either the standard revolving-screen or the small light-flume type.

An eight-page pamphlet entitled 'Oil Flotation—Oliver Filtration' has been issued by the Oliver Continuous Filter Co., San Francisco. The principle of flotation is briefly described, and as the concentrate is difficult to handle an Oliver filter is recommended to be used for de-watering. A number of these machines are used at the Anaconda and Inspiration flotation plants. Three cents per ton will cover the full cost of de-watering flotation concentrate, including interest, depreciation, and amortization. Plans and short descriptions are given of the filters. The filter was awarded a medal of honor at the Panama-Pacific Exposition.

A leaflet issued by the Nordburg Manufacturing Co., Milwaukee, Wisconsin, illustrates recent installations of its electric hoists, one page showing seven important details of construction. Large copper companies have recently purchased electric hoists from this firm.

EDITORIAL

T. A. RICKARD - Editor

DURING the first year of this War the people of the United States bought 660,000 motor-cars worth $500,000,000, or as much as the Anglo-French loan.

AT the present time the United States is like an unarmed man whose house is full of gold and food, while across the road a number of heavily armed gentlemen, in need of both gold and food, are engaged in a fight, from which one or other, needing much gold and more food, must eventually emerge victorious.

PROTESTS are being made in London against a possible tax on gold-mining profits. It does seem unwise to discourage the production of the necessary metal. We note also that a point is made of the fact that such profit is mainly a return of capital. Of course, it is; but before the tax-gatherer will accept the idea, those engaged in mining must believe it, and give proof of that belief.

AMONG the factors helping the copper market is the entire elimination of Australian metal, of which 11,000,000 pounds was imported into this country, for refining, last year and 14,000,000 pounds two years ago. Similarly the Mexican imports, which amounted to 40,000,000 pounds last year and 60,000,000 the year before have dwindled to 2,000,000 pounds during the first seven months of the current year.

GEOLOGY finds an honored place in our pages, when it does not disdain to be of practical service to the miner. In this issue we publish a valuable contribution on the geology of the Shasta copper region by Mr. Oscar H. Hershey, together with a map made by him to show the distribution of the ore-bearing rocks. We feel assured that this information can be applied to useful purpose by those engaged in mining.

RECENTLY we referred to the earth tremors or 'air-blasts' in deep mine-workings under a heavy overhang. On September 28 the Village Main Reef mine in the Transvaal was the scene of an unusually violent collapse of heavy ground, 3 natives being killed and 27 injured. If the accident had happened half an hour earlier hundreds of workers would have been killed. The dispatch says that the continued recurrence of tremors is causing anxiety in the vicinity.

LODE MINING in the interior of Alaska, as distinguished from the south-eastern coastal region, has been a big disappointment, but we hear news of promising finds in the Port Wells district, between Valdez and Seward, near the coast and north-westward from Juneau. The gold is found free in small quartz veins. Good results were obtained during the past season. We hear also of gold-quartz discoveries in the Willow Creek district, on the eastern side of Cook Inlet. Three promising mines are at work and other prospects are in course of development.

WORKERS in flotation will be grateful to Mr. Oliver C. Ralston for his suggestive article, and particularly for the avowed intention with which it is contributed, namely, the desire to help others in the work of research. That is just what is most needed at the present time, when the wide-spread desire to apply the process has outrun the technical information required to understand the physics of the operation. The laboratory of the Bureau of Mines at Salt Lake City is doing much useful work, setting an example that others will do well to follow.

NATURE laughs at us sardonically from time to time. Just when San Francisco is at the height of its celebration of the completion of the Panama Canal a slide of 10,000,000 cubic feet of rock blockades the new waterway that had been open long enough to prove its great service to mankind. The engineers appear to have made up their minds to accept the inevitable and allow the ground to slide into the Canal until the angle of repose has been restored. Unfortunately, the stoppage comes just before the annual movement of grain, but fortunately it comes at a time when the military use of the Canal is in abeyance.

ON October 19 the Government of the United States, supported by six of the South American governments, notified the representative of General Venustiano Carranza that the administration of which he is the chief executive is recognized henceforth as the *de facto* Government of Mexico. At the same time it was intimated that a diplomatic representative will be accredited shortly by the United States to Mexico. This event was marked by an entire absence of ceremony, but it lost none of its importance thereby. After nearly three years the two neighboring countries resume polite relations, and the Government of Mexico is accepted again in the comity of nations. We presume that this formal act will be followed by the placing of an embargo on the export of munitions to any Mexican faction remaining insurgent and that concurrently the sale of cattle and corn stolen by such insurgents will be stopped by the joint action of the two Governments. When this is done,

the ability of Villa and Zapata to continue in effective revolt will be taken from them. We expect a rapid disintegration of such remaining insurgent forces and a general acceptance of the Carranza régime. Señor Elisio Arredondo, Carranza's personal representative at Washington, has stated that "foreign capital will be welcomed" and a decree of amnesty will be promulgated at an early date. That presages a revival of mining activity and a resumption of smelting operations. For a while the lingering brigandage will hinder work in the outlying districts, but at the chief mining centres there should be but little delay in the re-opening of idle mines. The principal hindrance will be the condition of the railways, most of which have been 'shot to pieces' as the tide of civil warfare has advanced and receded. The railway from Vera Cruz to Mexico City appears to be intact, and the main line from El Paso to the capital should be placed in working order with as little delay as possible. That is the first step to the complete pacification of the country. On the whole, we consider the outlook more promising than at any time since February 1913.

FLOTATION is making good progress at Butte, not to mention its neighbor Anaconda. In addition to the Butte & Superior and Elm Orlu plants, treating zinc ore, there is to be a third flotation mill, at the East Butte mine, to concentrate copper ore. At the Butte & Superior the quality of the work continues to improve, the zinc content of the concentrate increasing from 50.27% in September 1913 to 53.61% in September 1914 and 55.92% in September of this year. Concurrently the recovery has improved, being 90.09, 89.69, and 92.79% successively in the corresponding month of each of the three years. The Butte & Superior is now obtaining 13,000,000 pounds of spelter from 41,000 tons of ore per month. We shall be enabled shortly to publish additional information concerning metallurgical improvements at the Anaconda, where something new and something worth-while is continually being developed to practical success.

Prospect and Retrospect

War, on a big scale, between great organized industrial communities, is catastrophic not only in its sacrifice of life and property among the belligerents, but in its sudden choking of avenues of commerce in one direction while opening new opportunities in another. A 'drive' in Flanders that wastes three million shells costing $18 apiece means a consumption of material and labor that provokes scanty remark only because the loss of life transcends it so greatly in significance. The floating of a $500,000,000 loan as an underlying lien on two great peoples is impressive, but the corollary to such a borrowing is apt to be pushed into the background, namely, the taxation that it imposes upon the productive energies of millions of Europeans in the years to come. In these days we take short views of life, our mental perspective has been shattered, we have learned from a single year's experience that the unexpected readily merges into the probable. A year ago New York, as a representative of the financial and industrial energies of the whole country, was in a state of acute depression; nobody foresaw that within so short a time the logic of events would make that city the chief financial centre of the world, for a time, at least. Suddenly the United States found itself grasping a commercial supremacy beyond the dreams of the most sanguine. By a great stroke of luck the opportunity came just after the Federal Reserve Act had organized the banking credit of the nation on a sound basis. Thus the issuance of international credits passed from London to New York. Coincidently the clearing of the Atlantic trade-routes by one of the belligerents guaranteed the big ferry-service required for the continued transfer of manufactured products and food-stuffs from our continental territory to the markets still accessible in Europe. A realization of the immensity of the consumption of munitions caused an enormous trade in such material to develop almost overnight, galvanizing the beneficiaries of it into herculean efforts to furnish an adequate supply. Early this spring a guess was made that $1,000,000,000 would be spent by the belligerents, chiefly the Allies, on purchases of munitions, food-stuffs, and supplies generally, to be exported from this country during the current year. This is known now to have been a low estimate. Meanwhile the mining industry, which supplies the metals required in the wasteful game of war, has revived in a manner wholly unexpected in the first months of the fighting. Mines that had been shut-down in response to idle markets, productive activity that was paralyzed by the uncertainties of the moment, and exploratory work that seemed futile during the early period of the Great Calamity alike were re-vitalized as soon as it became apparent that mining was destined to be signally stimulated by the requirements of world-wide warfare. The exploitation of copper ores, of course, profited by the demand for brass in a thousand forms, but the concurrent consumption of zinc had the more striking effect, causing the price of spelter to be trebled and even quadrupled, thereby turning relatively poor mines into veritable bonanzas. But this effect is now becoming widely distributed, from the chief metals it has spread to secondary mineral products like manganese, magnesite, tungsten, and molybdenite; indeed, there is scarcely any product of the mine in this country, at least, that has not risen rapidly in value by reason either of a greater consumption or a closing of foreign sources of supply. The consequence, naturally, is to expand the operation of existing mines, to promote the re-opening of old or abandoned properties, and to stimulate search for new ore deposits. As yet, the full effect is restricted by feelings of restraint and prudence, due to doubt regarding the persistence of present conditions. Assuredly we hope that they will not last, as far as concerns the diversion of the metals from peaceful consumption to the assistance of organized murder, but beyond the abnormalities of the immediate present we see the times of reconstruction and rehabilitation in which the metals will be required, not only as before, but more than ever before,

in the making of the wires of communication, the machinery of manufacture, the vehicles of transport, the roofing over new homes, and the domestic utensils required by the devastated regions of Europe.

Labor Troubles

Strikes are called 'labor troubles,' meaning that they are troubles caused by labor, yet they are quite as much capital troubles, whether we think them caused by, or only directed against, capital. It depends upon the point of view. That explains why most people escape the dilemma and impute the evil of unrest to agitators or anarchists, to autocrats or to tyrants, and thus discharge their responsibility by an epithet. The strike at the copper mines in Arizona and the visit of the younger John D. Rockefeller to the coal mines in Colorado have brought the subject to the front again, only a few weeks since the last Labor Commission closed its activities in the eruptive efforts of Mr. Frank P. Walsh, like a volcano that emits clouds of smoke and streams of mud ere it is extinguished. These labor disturbances have much in common. The strike that began at the copper mines of Michigan in July 1913 affected 14,300 men. It was made on the initiative of the Western Federation of Miners, previously responsible for the murders and assassinations that brought infamy upon the Coeur d'Alene, Cripple Creek, and Telluride districts twelve to twenty years ago. The mining companies were requested peremptorily to appoint representatives to meet this gang for the purpose of adjusting sundry grievances, of which it may be said that some were real, others unreal, and all subordinate to the necessity for refusing to deal with an organization so anti-social as that led by Charles F. Moyer. The usual lawlessness and aimless bloodshed were followed by a farcical governmental investigation, during which the strike petered out. But not before two good results had ensued: the concession of an 8-hour day was confirmed and it was proved that the Lake Superior copper region could not be terrorized by a band of conspirators from the outside.

Then came the strike at the coal mines of the Colorado Fuel & Iron Company in September 1913. That affected 11,700 men. The question at issue was the recognition of the United Mine Workers of America, an organization previously of good repute, but a national organization, and for that reason anathema to the mine management, which declined to deal with any but its own employees and refused to recognize those who, it claimed, had intimidated peaceful workers into antagonism against the company. A concentrated form of civil war ensued, with brutalities unspeakable; many were killed, the State militia proved incapable, the Governor had to call upon the President to send Federal troops, and order was restored finally in the wake of exhaustion. Later came the Government investigation under the chairmanship of Mr. Walsh, who used the opportunity to win notoriety by advocating a gospel of confiscation and stultifying the system of inquiry by commission. In the sequel, like a vaudeville after a melodrama, we have the visit of Mr. Rockefeller to the mines, with its belated effort to learn something about the big business for which he is responsible and the proposal of a scheme for joint conferences between representatives of the men and the company.

While Mr. Rockefeller is going through the motions of devising a scheme that will kill the union, another strike is in progress in the Clifton-Morenci district of Arizona, where 5000 men are now idle. This also involves the old issue of the Western Federation with Moyer as president, plus the further complication that the majority of the laborers are Mexicans. Owing to the narrow margin of profit derived from the exploitation of these particular mines, it has been found expedient to employ a cheap class of alien labor—Mexican, Italian, and Spanish. The relatively low wage-scale has given the Western Federation a lever whereby to cause an industrial upheaval. As in Michigan, two years ago, the managers have refused any dealings with the agents of the Western Federation, the mines have been shut down, and the usual methods of terrorism are being applied. The State militia is unable to overawe the disorderly elements, the Governor makes speeches calculated not to injure his political aspirations, and the Federal power is besought to come to the rescue. Meanwhile the protection given to the community is so uncertain that the managers of the three mines have gone to El Paso, in another State, explaining that their presence on the scene of conflict might serve as an incitement to riot, from which the Governor's words and actions furnish no hope of proper protection.

Here it is proper to remark that troubles of this kind are not restricted to any one region or any particular country. At the time when the Michigan strike was in progress, a similar disturbance—but of a more violent description—broke out on the Rand, among the 23,000 white workmen employed at the big gold mines of the Transvaal. This strike hinged on the refusal of the companies to recognize any union outside that of their own employees, but, after a riot, in which many were killed and all sorts of savagery ensued, the Government sent regular troops to restore order and insisted on fair play in the adjustment of grievances. The result was that the mining companies had to recognize the Miners Association of the Transvaal, but not the wider Federation of Trades, which had threatened to involve all South Africa in a comprehensive strike. That Federation was dominated by a lot of irresponsible hot-heads like its examplar in this country. It was a question not so much of collective bargaining, of the rights of capital and labor, of adjusting hours and wages; it was, and is today in Arizona, the question whether a Mafia or a Black Hand is to terrorize legitimate industry. In Michigan, in Arizona, in South Africa the bitterness of the struggle arose chiefly from the fact that the mine managements refused to recognize an organization that was less of a trade-union than a combination of professional agitators. And because that is the issue we can-

not expect a reasonable discussion of the relations of employer to employee. The anti-social anarchist must be eliminated before social arrangements can be made matters of friendly disputation. That or some other extraneous factor is always tending to prevent a dispassionate weighing of the merits of the case in these industrial misfits and misunderstandings. Yet no real cure of a chronic ill is possible until an unprejudiced diagnosis has been made. We shall return to the subject in our next issue.

Psychology of Advertising

On another page we publish a short article on this phase of journalism. It will call for no apology if it should interest our readers. We believe it will. In the first place, the reader should be aware that it is to the advertising that he owes indirectly his reading matter; the subscription to this paper, for example, barely pays one-third of the mechanical expense involved in the work of publication. Nevertheless it is the reader, not the advertiser, that the editor endeavors to please by the matter he offers in the form of critical and descriptive writings. The advertiser need not read the paper, it is not necessary that he should be interested in that way, but it is vital that the paper should interest the man who buys the machinery or supplies offered for sale by the manufacturer through the medium of advertisement; for until the reader has found something worth reading he is unlikely to look at the advertising annex. That is a fact of which most of us are well aware. If we read one article only in a magazine, we lay it aside without looking at the advertising pages, but if we hold it in our hands long enough to read more than one article we are pretty sure to continue holding it while we turn over the advertising pages. Then the manufacturer is given a chance to deliver his message, which is an offer to sell something that he makes. The chance being given, by the attractiveness of the reading pages, it remains for the manufacturer to present his advertisement so that it will command attention. He does not always succeed. Sometimes it is his fault; sometimes that of the reader. On the whole the latter must be absolved, if of average intelligence, for he is the one that ought to be suited. Fortunately the men that buy machinery are not slow-witted; they are men of trained intelligence and keen insight. Therefore the advertiser can afford to address them as if they were his equals mentally. Most blunders in advertising arise from a failure to appreciate this simple fact. To be convincing, one must be sincere. To impress another man it is necessary to employ the language he can comprehend. That is the rule of all effective writing: remember the reader. Unfortunately for the advertiser, the proprieties prevent an editor from preparing the advertisements, otherwise it might seem well for him to supervise both parts, the reading and the advertising, of the paper, since both are prepared for the edification of the same persons. What a time the poor editor would have in preparing advertisements for rival firms, to be equally serviceable and yet differently worded, to be competitive yet not mutually contradictory, as competitive claims sometimes are! We have heard that this has been tried, with humorous results. But we prefer to dismiss the nightmare thought, passing to consider other aspects of this delicate—and therefore interesting—problem. In order that the subscriber, the man engaged in the business of mining, may look at the advertisements, he must first be persuaded to look at the reading pages; therefore the reading matter must be interesting; and to be that, it must be honest; in short, the reader must be able to trust the editor not to abuse his confidence. Hence the reading matter must not emanate from the advertiser, it must not be modified or influenced in any way by him, it must be entirely independent of him, both in fact and appearance. The body of the paper must be prepared with the sole idea of interesting, that is, assisting and informing, the men in charge of mining and metallurgical operations. On the other hand, the advertising pages should be prepared with a view to holding and continuing that interest so that their message may lead to business, now or in the near future. Hence the advertiser ought to study the reading pages and learn from them what kind of language to talk: how to approach his putative customer. To send the same advertisement with the same wording in its appeal to papers commanding diverse clienteles is not wise. An announcement in the *Ladies' Home Journal* should be couched in phraseology different from that used in the Mining and Scientific Press. Heart-to-heart talks on pillow-shams will not move a hard-headed engineer, nor will the terse technical terms of a manufacturer strike home in the heart of a gentle schoolteacher. The editor, and his co-workers, the contributors of articles, may make mistakes—being human, that is inevitable—but they must play square, they must not attempt to deceive the reader with 'write-ups,' 'reading-notices,' or any other simulacra of technical information prepared by the advertiser as a means of obtaining gratuitous publicity in an underhand way. The advertiser who persuades the editor to publish such stuff should ask the business manager for a 25% discount on his bill, for the publication of it has the effect at once of spoiling the effectiveness of the advertising by causing possible customers to cease reading the paper. In short, the safety of a professional paper, such as this, must depend upon a water-tight compartment between the editorial and the business offices: not a line of reading matter should be purchasable, not the fraction of an advertising page should be gratuitous. After all, it is a clean-cut business; it affords an example, none too common, of honesty being the best policy, of square dealing being the most profitable. If we can hold the attention and confidence of the mining and metallurgical profession, the business men, the superintendents, and the foremen engaged in the daily work of mining, we shall not need to fear the result. The paper that commands the trust of the profession will win the support of the trade.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

The Engineer as a Mine Operator

The Editor:

Sir—The question is frequently asked: Why do not more of the competent mining engineers, now apparently content to hold subordinate positions with large mining corporations, in which there is little opportunity to show their full ability, and where individuality is sometimes destroyed, identify themselves with new development enterprises? The risk is, of course, greater, but the chances for success on a large scale are more promising.

I notice that some prospectors go so far as to intimate that the engineer is in a class with the fortune-teller, who takes the public money for giving information, but does not think enough of his own judgment to put it to the test. Every field-geologist knows that on this terrestrial foot-stool there still remain many virgin fields of promise.

We all know that the paramount weakness of the many newly organized so-called development companies is mining brains. Why then, asks the uninitiated, does not the engineer avail himself of the opportunities presented by this form of enterprise and become immediately a big frog in a small but expanding puddle?

Most of us, I think, before losing hope, have tried the above plan in one or more of its many forms. As one who has tried strenuously this shorter road to gain and glory, I shall tell what to me is the most discouraging aspect: the insupportable incubus, the Nemesis who pursues, the Old Man of the Sea who rides, the Albatross which hangs round the neck of the pioneering engineer. To my mind, it is the irreconcilable difference in the business ideas and ideals of the mining engineer, and the type of promoter usually found with, and supposedly necessary to new mining enterprises. I do not refer to the great promoters who father mighty enterprises, because they are men of great ability, knowledge of the business to be undertaken, personality, foresight, and faith. Without such men there could be little advance made in any line of endeavor. Nor is reference made to the fly-by-night scoundrel who is a plain thief. The man who has put gray hairs before their time among the red ones on the writer's dome is the promoter, usually honest within certain limits, but whose training as a salesman has taught him that the proper procedure with the prospective investor, is, by hot-air applications etc., to so enthuse, blind, bewilder, and befuddle him with visions of immediate wealth, that Mr. Investor's involuntary grip on his judgment slips a cog, and before he regains himself is in for a few hundred or a thousand dollars.

After No. 1 has been properly hooked and the loose change shaken out of his pockets, the plan is to rush joyously on to the next victim. A promoter once said to me: "If I don't get a man the first time, I never go to see him again."

Of course, the engineer, by inclination, training, and tradition of the Elders is a man who thinks along straight lines. Everything is either a fact or a fallacy to him. Fuss and fiction disturb and disgust him. Because he has the imagination of a builder, a good clean promising prospect is the most alluring object in the world to him. He studies this prospect from every angle within his experience, and finally decides that with proper development his little acorn may become an oak some day. He prepares a careful, conservative, truthful report of the property under examination, turns it over to the financing genius who frequently is also president, general manager, major domo in chief of the company, and he scans this report with but one thought, and that is to learn the 'talking points' of the proposition. And should these 'talking points' be not sufficiently emphasized, the report is returned to its author with some helpful suggestions for its betterment. To the promoter the only good report is one which shows the chances for loss to be minus zero, with chances for success infinity plus, a report which, like the moon, presents but one side, and that the shining one.

Sometimes the promoter tries, if the engineer is at a sufficient distance, to improve the report himself. Here are a few instances in the writer's personal experience. In the sentence "The Bull Whale property has considerable young timber suitable for lagging purposes," the word 'lagging' was changed to 'logging.' In the sentence "The Pipe-Dream vein is not extensively faulted as previously supposed," the word 'extensively' was omitted in the printed circular.

A promoter once asked me if true fissure veins did not always increase in volume and value with depth. I told him that was not my experience, and asked who had given him such an idea. He named R——, a notorious charlatan, whom he said had told him that these metaliferous masses were intruded in a molten state from abyssmal depths, and that during the cooling process, by reason of their specific gravity, the heavier metals gravitated downward. For that reason a uniform increase in values was to be expected, especially in the very heavy metals, such as gold. This seeker for information then wanted to know my 'theory.' I gave him an elementary lecture on ore deposition, at the conclusion of which he

exclaimed: "Then the ore don't always go down?" Unfortunately, no. His reply was "Your theory ain't worth a damn to sell stock on. I'll stick to R——'s."

The promoter usually trys to start off his proposition with a blare of trumpets, and after the initial frenzy to keep up the fever with inflammatory telegrams, and flamboyant letters. And if the engineer at the mine is an honest man and tells the promoter of a nice warm place where he may spend his winters, the promoter is not subdued, but simply comes from some other angle. In fact, invective may be used upon him, until it becomes trite, to no avail. And the usual result is that the engineer quits in disgust, or a fight is developed which usually ruins the enterprise.

The fault is not all the promoter's, for a sufficient number of engineers have lent themselves to the abominable buffoonery and chicanery of the professional stock juggler to warrant the hope that others may develop a yellow streak. And by their chimerical statements they have cast discredit upon the profession. The deserter always makes it harder for the man who stands by his guns.

Another fault of engineers, and one to which the writer confesses is that we spend too much time away from the centres of capital. We give too little thought to financing problems. Most of us could and do inspire confidence and trust in those who know us. But we do not know how to reach the man who could, with one stroke of his magic wand, transform our little acorn into the great oak of our dreams.

CLYDE M. BECKER.

Deming, New Mexico, September 27.

Flotation in Australia

The Editor:

Sir—We have just read the article on 'Flotation in Australia,' by Charles S. Galbraith, published in your journal issued on the 17th of July last.

The statements made by Mr. Galbraith in relation to Mr. A. de Bavay, the inventor of the process used by this company, are quite inaccurate. Mr. Galbraith was appointed manager of the company's experimental works on December 18, 1906, and was in the employment of the company until March 7, 1907, about three months. This fact speaks for itself.

Mr. Galbraith states that Mr. de Bavay is a Frenchman. That is not so; Mr. de Bavay is a Belgian. The exposition of Mr. de Bavay's views in regard to the agency of flotation and the way his discovery was made are absolutely incorrect. Mr. de Bavay perfected his invention from the initial to the present stage without any assistance—certainly Mr. Galbraith was not of any assistance to him.

Mr. Galbraith states "that it was only when the inventor was put aside and the management allowed to get to work that success was achieved." This is absolutely untrue. Mr. de Bavay has not only the honor of being the inventor of the process which bears his name, but he developed it to a successful commercial issue.

Since this company started operations, 2,562,000 tons of zinc tailing has been treated for the production of 730,000 tons of concentrate, averaging 49% zinc, 6% lead, and 9 oz. silver per ton, and £475,000 has been distributed in dividends to the shareholders.

We trust that, in justice to Mr. de Bavay, you will give this refutation of Galbraith's statements a prominent space in your paper.

EDWARD H. SHACKELL,

Secretary, Amalgamated Zinc (De Bavay's), Ltd.

Melbourne, September 22.

Efficiency Engineering in Mines

The Editor:

Sir—I have read with considerable interest Mr. P. B. McDonald's letter in your issue of September 4. Kindly allow me to make a few remarks on this subject myself.

Efficiency engineering as applied to mining is, at present, in what might be called its embryo stage, and any examples which may be cited against scientific management should not be taken as final in order to condemn its introduction into the mining industry. A careful study of such failures will usually bring out the fact that the system which was being introduced was not the true Taylor system, but an unscientific modification made by the man in charge. The Taylor system does not advocate "spying" on the men, therefore we cannot consider as an example of the failure of scientific management in mining that mine in Michigan where attempts at 'Taylorism' were made, as was stated by Mr. McDonald.

As is the case with mining now, so it was in the manufacturing industries ten or twelve years ago—a great deal of opposition existed on the part of the workers. That this opposition has greatly decreased where the workers have a clear understanding of what scientific management really means is shown by their preference to work in factories which have adopted the system. That this system creates a greater loyalty between the workers and the management is plainly seen from the opinions of the men in a shop under scientific management. In an article on 'Scientific Management as Viewed from the Workman's Standpoint,' published in *Industrial Engineering*, November 1910, the writer quotes the opinions of some of the workers, and then adds: "Conversation with other men brought out practically the same facts. They are all contented. They took pride in their work, and seemed to be especially proud of the fact that they were employed in the Link-Belt shops."

Any system of management, in order to be successful must have an harmonious co-operation between employer and employee. This co-operation is essential to their highest common interests, and no management can consider itself adequate if it does not try to enter into the mental attitude of its workers. According to Taylor himself, there must exist an "intimate friendly co-operation between the management and the men."

Under scientific management this co-operation on the

part of the workers is the result of, first, the assurance of an increase in wages for an increase in effort; second, the assurance that their health will not be harmed if they follow instructions; third, the personality of the manager or superintendent. In plants operated under the old type of management this co-operation is only dependent on the personality of the manager. A good example of this co-operation or willingness to work, because of the worker's admiration for the general manager, is the case cited by Mr. McDonald of that mining company in New York state.

Scientific management deals directly with the labor problem to a greater extent than any other type of management, consequently an innovation of this kind is, naturally, looked upon with suspicion by the workers. Also, the name has been occasionally, and unfortunately, applied indiscriminately to any sort of system of operation which has not the interests of both the management and the workers at heart, with the result that this suspicion has been greatly increased. It is, therefore, but natural that a good worker under the old type of management should be sensitive to what he is inclined to believe are 'criticisms' by scientific management with regard to him. Only through tactful dealing with the workers can this suspicion and resentfulness be removed and their co-operation assured.

To conclude, scientific management must be introduced by an expert who is able to get along with the men, and can get them to co-operate with him.

Until further studies are made on the application of the Taylor system to mining, we have to content ourselves with the results achieved in the manufacturing industries as to the practicability of the system.

JOHN R. H. H. BILLYARD.

Berkeley, California, September 14.

Office Etiquette for Busy Men

The Editor:

Sir—A frequent pose among men who have but little business is to keep a caller sitting in the outside office while the incumbent amuses himself by cutting foreign stamps from envelopes or talking about the last golf-game. The visitor is impressed by the vast amount of business transacted—unless indeed he suspects the truth, that the waiting is done for effect. Much the same end was achieved by a young doctor of our acquaintance who had a friend call him out of church every other Sunday to impress the congregation with the great demand for his services. A little elementary instruction on the treatment of office-callers seems desirable. We suggest that a caller should not be kept waiting more than five minutes. If Jones, who is in his office, is too busy to see Smith within five or ten minutes, he should come out for a moment, greet Smith with extended glad hand and pleasant word, explain that he is busy and send Smith on his way rejoicing, and, if required, make a definite appointment for the next visit. All this should take from twenty seconds to a minute, at longest, and will leave a pleasant impression on Smith's mind; while the cooling of the heels in the anteroom generates hot wrath in the heart. We remember with extreme dissatisfaction, our formal call, some years ago, on the secretary of an important technical society, whose offices are on the Atlantic seaboard. On the other hand, pleasant memories come to mind of a busy financier's kind and friendly explanation of the reasons he was unable to see us. The memory of his few seconds courtesy will never be effaced, while subsequent pleasant visits with the secretary have not yet obliterated the disagreeable impression of the first visit.

JOHN WORDEN.

San Francisco, September 24.

Accidents in Mines

The Editor:

Sir—In your issue of October 9, I note your article in reference to the discussion of accidents in mines, at the meeting of the American Mining Congress during its session of September 22, wherein you invite discussion of this subject. My experience of thirty years in the management of mines has left no doubt in my mind that most accidents to men underground are due to carelessness of the men. I fully agree with Mr. Day and with you.

Most of the accidents that have happened in the Utica mine were caused by boulders rolling down broken piles of rock where the 'muckers' were shoveling, undermining the piles in search of the smaller broken particles and dodging the boulders that needed breaking with a hammer, leaving them for the next shift.

The men will take all manner of chances at this, including the penalty of being discharged, since we have a strict rule that rock-piles must be kept safe, by picking down from the top and keeping the slope such as will preclude the possibility of boulders rolling down of their own weight. We have discharged men time and again for this, but they persist in taking the risk.

Another breach of care, to be noted almost every day, is their neglect of carefully picking and barring down loose rock after blasting. One would think that any miner would consider personal safety to that extent, but no, there is hardly a day when I am underground that I do not discover one or more examples of such carelessness. I always carry a heavy and long-pointed candlestick, and I often pry down boulders, which had they fallen on anyone, would have caused serious injury, to say the least. And often they require little or no prying. It is no use to fire the guilty parties, because I have found that they are pretty much all alike, and we would have a constant shortage of men. But in flagrant cases, we give them a good 'jacking up.'

Most accidents are due to a spirit of taking chances, miners being a dare-devil lot. Everyone who has had practical experience will agree with me in this. Those who hold otherwise are theorists and of the class of bachelors, male and female, who write such apparently convincing articles on the care and training of children.

Angels Camp, Cal., October 12. F. J. MARTIN.

Psychology of Advertisements

By P. B. McDONALD

A mine-manager is reading a mining weekly; he reads first a well-written and suggestive editorial; then he turns to a special article on a subject in which he is interested, signed by a name that he knows insures lucidity of thought; he next scans a news-letter from a mining centre, and then—then he reads the advertisements! If the subscribers to the mining periodicals did not read the advertisements, the latter would soon cease to be published.

The mine-manager reads two or three advertisements carefully and thoughtfully; they describe products of which he has heard and which he thinks of introducing at his mine. Perhaps they are electric locomotives for underground haulage, or ball-mills, or drill-column hoists, or mine-telephones, or dump-cars, or filters, or rope-drives, or ore-crushers, or conveyors. What the manager is thinking is this: "Will they do our work satisfactorily; I wish I knew more about them; what's the idea of this particular type? for what purpose is that handle? how is regulation effected?" It is true that a note in the corner of the page states that pamphlets or catalogues describing the product will be sent on request. But a mine-manager is a busy man and has but little time to give to each machine with which his mine is equipped. Moreover, his experience with advertising pamphlets has been that they are less understandable than a railroad time-table and such a mixture of haphazard facts mixed with blatant boastings that only a Philadelphia lawyer can distinguish where one begins and the other ends. It is passing strange that a manufacturer who pays for a page of advertising does not use it to tell the readers what they want to know about his product, much as he would do if he were talking to them. Instead, the page is used for printing, in big letters, exaggerated statements of the 'live-wire' variety, full of 'punch,' which mean nothing in particular, and which nobody believes.

After studying two or three advertisements carefully, the mine-manager examines several others hastily. They are advertisements of standard products that need no explanation. Their appearance in the advertising pages is the equivalent of a pleasant meeting with an old friend. Seeing the advertisement every week assures him that the manufacturer is alive, and encourages the feeling that the product is well made; at least that it is not deteriorating.

A certain part of the manager's thinking as he slowly turns the advertising pages is unconscious. He reads the names of the various articles advertised and the addresses of the firms selling them, while sub-concious impressions are being recorded in his brain. The repeated seeing of the advertisements of any particular article will inculcate a belief that the article has merit; and when the time comes to buy, the advertised product will loom up as the sort that is wanted, the superior variety of assured excellence and quality. This is the great silent argument of advertisements, the conception and growth of confidence in the product, the quiet instilling of belief in its usefulness, the feeling that here is worth and satisfaction.

When an article has been advertised steadily and then the advertising is stopped, the thought quietly spreads that the product is declining and that the firm is perhaps losing its position. The former feeling of confidence and optimism in the product becomes replaced by the suggestion that all is not well with the manufacturer, and doubt is manifested as to the ability of the firm. Something appears wrong somewhere, and the goodwill diminishes.

The advertiser in a technical journal should distinguish between the sort of man he is trying to impress and the people for whom articles are advertised in popular magazines. Advertisements in the latter are intended to appeal to a gum-chewing public that knows little and cares less about realities. Mine-officials and engineers, on the other hand, are picked men of unusual keenness and ability, men distinguished from the public that giggles in picture-theatres by years of training, experience, and the consideration of serious problems. An advertisement that might be believed by the readers of a weepy magazine would only awaken amused contempt from a mine-superintendent who has been trained to see things as they are, and who is not at all impressed by 'live-wire' nothings or glorified 'punch.' Yet the ordinary mine-official is constantly on the watch for new machinery and equipment that will save labor or expense, and he is always open to suggestions and arguments that are backed by the logic of facts. He likes to be addressed by the advertiser as if each knew their own business: the serious unpretentious talk of one sensible man to another, not that of a corn-doctor to a passing mob. Mutual confidence is the first requisite to the transaction of business.

MINERAL exports of Peru during the first five months of the current year are as follows, compared with that period of 1914:

Mineral.	1915.	1914.
Antimony	1,315.24	120.14
Bismuth (barilla or concentrate)	210.59	141.27
Copper (barilla or concentrate)	2,036.88	367.72
Silver ore	32.79	35.47
Tin (barilla or concentrate)	17,055.09	18,286.95
Wolfram (barilla or concentrate)	243.34	107.91

The above are in metric tons of 2204 lb. The value of the exports is affected by the lower rate of exchange for the *boliviano*, which is now worth 30c., against 36c. in the early part of 1914.

MINING LITIGATION is an expensive luxury. It is stated that the lawyers' fees in a recent California apex-suit amounted to $60,000. This is a large sum, but the fees of a half a century ago were equally high; for example, Senator William M. Stewart states in his 'Reminiscences' that in four years he received $500,000 fees in the Comstock litigation.

Why Do Minerals Float?

By OLIVER C. RALSTON

*I was very much interested in reading an article by Charles T. Durell, appearing in the PRESS of September 18, under the caption 'Why Is Flotation?' However, I find myself unable to agree with Mr. Durell's line of argument, and for the following reasons:

In the first place I believe that Mr. Durell has used loosely some rather obscure scientific terms which may cause unnecessary confusion to anyone not thoroughly familiar with the physical chemistry involved. The term 'nascent gas' is especially open to criticism. Doubtless Mr. Durell means the dissolved gas that can be liberated from the water, but this is hardly the ordinary sense of the term, and many modern physical chemists will object to the use of the word 'nascent' under any conditions whatever, or even refuse to recognize it, in spite of the old ideas that grew up around it. However, it may be that 'nascent' is a good term to use here in a figurative sense. Another term used by Mr. Durell and to which an objection might be raised is the word 'occlusion' as applied to the gases held by minerals. Mineralogists have long used this term rather loosely, but Mr. Durell does not seem to have taken it up in the same sense. As I understand it, there are three ways other than in visible openings by which gases can be held in solids;[1] these are:

1. In solid solution, in the same way that gases can be held in liquid solutions.

2. In surface adsorption, where the layer of gas immediately in contact with the solid is found to be more or less tightly held by some force of attraction, unnamed, and is hence considerably compressed.

3. In occluded form. This is a term the meaning of which has been much disputed; it is often used in the sense of one or the other of the terms above mentioned. Of late there has been a tendency to call occluded gas any gas that seemingly is held in some manner different from that designated by either of the other two terms, and in a manner not exactly understood. An example is found in certain substances that are known to be finely porous and that seem to hold gases in neither solid solution nor surface adsorption. Charcoal is such a substance. Possibly these have pores of such small diameter that they are of the same order of magnitude as the thickness of the adsorbed layer of gas, so that most of the gas held in them is present in a highly compressed condition. Charcoal absorbs so much CO_2, for instance, that at ordinary temperatures the volume of CO_2 held is enough to fill the known pore-space at a pressure sufficient to liquify it.[2]

There doubtless are very fine openings in our crystalline sulphides, and they admittedly do hold some occluded gas, but good cases of occlusion have been found thus far only in amorphous substances like charcoal, hair, wool, glue, meerschaum, starch, etc. This fact tends to cast a doubt upon Mr. Durell's hypothesis that the occluded gas in the flotative minerals plays an active part in the attachment of gas bubbles to the surface of the mineral.

Another physical fact that casts further doubt on this hypothesis is that occluded gases (and dissolved gases as well) are liberated from the substances occluding them only with difficulty; the last traces of them are still held even when the substance is placed in a high vacuum and heated to a considerable degree. It is as though the molecules of the gas were diffusing out through very small clogged pores. How this tightly-held gas could be liberated fast enough to compare with the exceedingly short time which it takes to accomplish flotation of a sulphide particle, is difficult to explain physically. Mr. Durell has further supposed that there is an osmotic travel of ions from the water solution, in which the ore pulp is made up, directly into the fine openings of the mineral particles. The surface of the particle acts as a septum and at the same time the molecules of the gas diffuse out and join the air from the solution, forming a bubble that floats the mineral. At the present time I cannot see my way to accept Mr. Durell's supposition. Briefly stated, then, Mr. Durell's hypothesis is that "nascent" gas from the water and "dissolved" gas from the solid meet and collect at the surface of the solid until a bubble large enough to lift the particle is formed, while the purpose of an oil is to form a persistent froth so that the particle will not be dropped back into the pulp. I am of the opinion that all the phenomena cited by Mr. Durell constitute no proof of any part of his hypothesis, but only furnish the basis for an inference that such could be the case. Whether it is possible to get flotation from water containing no dissolved gases and with minerals that have been treated for the removal of their occluded gases, no one knows. Possibly Mr. Durell is right when he says that "this phenomenon is worthy of investigation," but, on the other hand, I believe that flotation can be explained more satisfactorily than by the conjecture that well crystallized minerals, such as the metallic sulphides, contain important amounts of either occluded or dissolved gases, and that they contain these gases in any greater amount than do the equally well crystallized gangue-minerals, such as quartz and feldspar. That sur-

*Communicated by D. A. Lyon, metallurgist in charge of Utah Experiment Station, U. S. Bureau of Mines and Department of Metallurgical Research of University of Utah, Salt Lake City, Utah. O. C. Ralston, assistant metallurgist.

[1] *Philosophical Magazine*, Vol. XVIII, page 916, 1909.

[2] See the researches of Sir James Dewar on charcoal, published in various volumes of *Chemical News*.

face films of adsorbed gas or air exist and may be of great importance, I firmly believe, but there is little evidence of any great difference in the amounts of this gas on gangue and on flotative minerals.

As I understand Mr. Durell, the sole use of the oil in froth-flotation is the formation of a tougher liquid film around the bubbles of air, so that the resulting froth is more persistent. Mr. Rickard[3] has pointed out that various writers have continually made the statement that the surface tension of water is *increased* by the addition of the oil, while as a matter of fact it is *decreased*. This fact Mr. Durell acknowledges, and yet he states that because the surface tension of the water is decreased the tendency to float is likewise decreased. He implies that the reason is because the bubbles burst more easily. This seems strange, but in the absence of further data we can let it pass. My main comment is that while Mr. Durell believes that the only function of oil is the toughening of the surface film, we are not sure that such is the case. His hypothesis about "nascent" gas and "occluded" gas does not require the presence of oil; hence he has had to explain the use of oil or abandon the hypothesis.

Although I consider that Mr. Durell should be applauded for his courage in putting forward a hypothesis concerning a subject that has been of so empirical a nature up to date, nevertheless I have felt the necessity for challenging Mr. Durell's hypothesis and of taking the liberty of advancing what seems to me to be a better one.

There are two such hypotheses which seem to be equally possible and it is not certain but that the two simply cover parts of a greater fact. One hypothesis can be stated in terms of the inter-facial tensions involved, and the other in terms of the electric charges residing on suspended particles.

The first hypothesis is based on some academic work done by Reinders.[4] He based his work on some equations that Clerk Maxwell[5] had derived from fundamental thermo-dynamic laws, leading up to a certain set of inequalities between inter-facial tensions of the phases involved. By 'inter-facial tension' I mean the state of strain existing at the zone of meeting of any two dissimilar phases. The surface of water in contact with air is under a strain which we call 'surface tension,' so that this surface acts like a tightly-stretched rubber membrane. Likewise the inter-face between a solid and water and between a solid and air or between oil and water is under a similar strain. Allusion has been made already to the surface adsorption of air on solids. The inter-facial tensions of many pairs of liquids are known, as well as the surface tensions of all manner of liquids in contact with all manner of gases. However, the inter-facial tensions of solids in contact with liquids have never been studied thoroughly on account of the difficulty of getting measurements that mean anything. Reinders deduced the following inequalities as applying to the case where a powder, or the particles of a colloid, is suspended in a liquid to which is added a second liquid that is immiscible with the first. Let us assume that the first liquid is water and the second oil, then expressing the inter-facial tension between the solid and water as $T_{(s,w)}$, the tension between water and oil as $T_{(w,o)}$, and the tension between the solid and oil as $T_{(s,o)}$, Reinders stated that:

If $T_{(s,o)} > T_{(w,o)} + T_{(s,w)}$ the solid powder will remain suspended in the water.

If $T_{(w,s)} > T_{(w,o)} + T_{(o,s)}$ the solid will leave the water and go into the layer of oil.

If $T_{(w,o)} > T_{(s,w)} + T_{(s,o)}$, or if none of the three tensions is greater than the sum of the other two, the solid particles will collect at the boundary between the oil and water.

It hardly needs to be said that here we find something very close to the conditions obtaining in the flotation process. In fact, the old Elmore bulk-oil flotation method fulfills exactly the conditions that Reinders had in mind. Below are given some tables of results obtained by both Reinders and Hoffmann[6] in an experimental way, by suspending a definite powdered solid in water, adding a second immiscible liquid, and shaking. The letter *w* means that the powder remained in the water; the letter *o* means that the powder went into the oil layer; the letter *s* means that the powder went to the surface separating the oil from the water; and symbols like *s*(*w*) or *s*(*o*) mean that there was a good deal more of the powder in the inter-face than in the bracketed phase. Similar results were obtained with colloidal solutions.

TABLE OF REINDERS' RESULTS

Water and	Paraffin oil.	Amyl alcohol.	CCl_4.	Benzene.	Ether.
Kaolin	w	w(s)	w(s)	w	w(s)
CaF_2	ws	ws	w(s)	w(s)	w(s)
Gypsum	w	ws	w	sw	ws
$BaSO_4$	w(s)	ws	ws	sw	ws
Magnesium ..	ws	ws	ws	ws	ws
PbO	s	s	sw	s	sw
Malachite	so	s	s	s	sw
ZnS	s	s	s	s	sw
PbS	so	so	s	s	s
HgI_2	so	s	s	s	s
Carbon	so	s	s	s	s
Selenium	so	so	so	s	s
Sulphur	so	so	o(s)	so	s

Hoffmann worked a great deal with chemical precipitates and other artificially prepared products. However, the laboratory method involved ought to be good in the study of flotation processes for a possible method of floating oxidized minerals. Then it might be possible to convert a successful bulk-oil process into a frothing process in the same way as the old Elmore bulk-oil method went through the stage of granulation and classification to a final frothing process such as we see today. I have done some work along these lines and have planned considerable research work in the same direc-

[3] M. & S. P., Sept. 11, 1915, page 383.

[4] *Kolloid Zeitschrift*, 13:235, and *Chem. Weekblad*, 10:700.

[5] *Encyclopedia Britannica*, on 'Capillarity.'

[6] *Zeit. physik. Chem.*, 83:409, 1913.

tion. Meantime these notes might as well be available to others in suggesting lines of useful research. The comments to be made on the above tables are without end, but the tables are given here mainly to suggest the possibilities of further work.

The question arises as to whether it might not be possible to apply a set of inequalities such as those of Reinders, or even to apply Reinders' inequalities direct, in the prediction of results for froth flotation. In froth flotation we have at least four phases—solid, water, oil, and gas—unless the oil happens to be soluble in water,

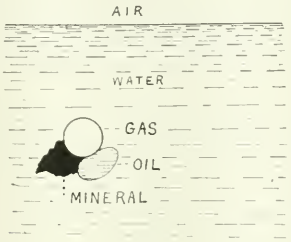


Fig. 1.

in which case we are reduced to a solid, a solution, and a gas. We have inter-facial tensions between each two of the phases, making six tensions altogether, and mathematical expressions covering such a case must necessarily be much more complex and exhibit a greater number of possibilities. The problem is more difficult, but it should be capable of solution. Fig. 1 shows a fanciful magnification of one possible arrangement of the particles of solid, droplets of oil, and spherules of air, in the liquid of the ore-pulp, being subjected to flotation, at the moment when a bubble begins to raise a particle of mineral to the surface.

Fig. 2 shows a possible way of applying Reinders' inequalities direct without any modification. It is assumed

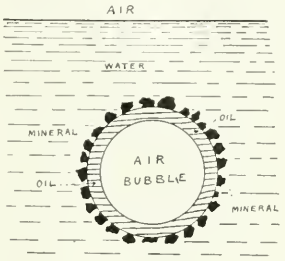


Fig. 2.

that the oil forms an envelope on the inner surface of the air bubble so that the air is nowhere in contact with water. Mr. Rickard[7] has called our attention to the

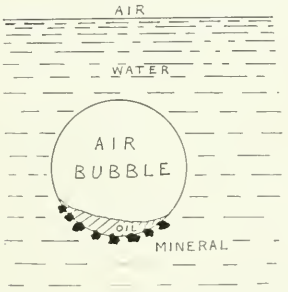


Fig. 3.

Table of Hoffmann's Results

Water and	Ether.	Chloro-form.	Butyl alcohol.	Benzene.	Kero-sene.	Amyl alcohol.	Paraffin oil.
$CaSO_4$	w	w	w	w	w	w	w
SnO_2	w(s)	ws	ws	s(w)	sw	sw	sw
$Al(OH)_3$	w(s)	ws	ws	s	s(w?)	sw	s(w)
SnS	ws	ws	ws	s(w)	s(w)	s	ws
$BaSO_4$	ws	ws	ws	s	s	s(w?)	s(w?)
ZnS	w(s)	ws	ws	s	s(w?)	s	s(w?)
ZnO	ws	ws	s(w)	s	s	s	s
$CaCO_3$	ws	ws	s	s	s	s	s
$Mg(OH)_2$	s(w?)	ws	s	s	s	s(w)	sw
Al	sw	s(w)	s(w)	s	s	s(w)	s
$BaCO_3$	ws	ws	ws	s	s	sw	s
CuS	ws	s(w)	s	s	s	s	s
$PbCrO_4$	ws	s(w?)	s	s	s	s	s
Cu_2O (?)	ws	s	s	s	s	s	s
MoS_2	s(w?)	s	s	s	s	s	s
PbS	ws	s	s	s	s	s	s
Fe_3O_4	ws	s	s	s	s	s	s
$BaCrO_4$	ws	s	s	s	s	s	s
Pb_3O_4	sw	s	s	s	s	s	s
C	sw	s	s	s	s	s	s
PbI_2	s	s	os	s	s	os	s
HgS	s	s	s	s	s	s	s
HgO	s	s	s	s	s	s	o
HgI_2	s	s	s	s	s	o	os
AgI	s	s	o	s	s	o	os

work of Devaux, published in the annual report of the Smithsonian Institute, in which it was found that a droplet of an oil when placed upon a plane surface of water will spread, of its own weight, until it forms a film only one or two molecules thick. This fact allows an explanation of how the small amount of oil used in the froth-flotation processes could be so efficient. If it so happens that the oil could coat the inner surface of an air bubble, the powdered mineral would be able to take up a position on the inter-face between the water and the oil without any reference to the air in the bubble.

By reason of the known low adhesiveness of oil and water it is doubtful if the air bubbles could be completely mantled by oil, as the oil would be too liable of its own weight to slide down to the bottom of the bubble to the position indicated in Fig. 3. Even here, the oil could carry mineral on its water inter-face (in case the oil and water do actually get into contact) and Reinders' criteria would still apply. In a Callow flotation machine having glass sides it is sometimes possible to see particles in just such a position. However, this case does not prove that the top side of the bubble is coated with oil or mineral, while the bubbles of a mineral froth on top of the pulp are seen to be covered completely with particles of mineral.

If the mineral tends to enter the oil phase completely and leave the water, the mineral grains present only an oil surface and in case oil droplets tend to collect at the inter-face between water and air (by Reinders' criteria) we could have the case illustrated in Fig. 4. This case, as well as the one illustrated in Fig. 2, would allow of the air bubbles becoming completely covered with oiled mineral.

Other phases are possible, but these are given to show how very feasible it is to get an explanation of flotation in terms of inter-facial tensions.

In an investigation conducted by the Minerals Separation, the 'contact angle' of various minerals with water was examined to find at what angle the mineral had to come in contact with a water surface before it was wetted and could sink.[8] A glance at Clerk Maxwell's famous paper on 'Capillarity,' upon which Reinders' work is based, will suggest immediately the explanation of a contact angle, and that it is the result of a certain equilibrium of inter-facial tensions of air, water, and solid. Valentiner[9] has likewise investigated the contact angle and its hysteresis under certain conditions and has connected it very definitely with capillary phenomena. There can be no doubt that there is a close parallelism between the angle of hysteresis of the contact angle and the ability of a mineral to float. But if we go no further than to observe the parallelism we cannot designate the statement of the parallelism as a theory, although we might be able to predict by its means whether a mineral would float.

To go into this a little farther, and indeed along the line suggested by Mr. Durell, we ought to consider the properties of the surface layers of the substances involved. For example, the plane surface of water in contact with air is known to have considerably different properties from the inner bulk of the water. In Fig. 5 the film is shown magnified in thickness. It acts like a tightly stretched elastic skin, due to what we have long called a 'surface tension' of 81 dynes per centimetre, as is usually given in text-books. (This means that for a strip of the surface film one centimetre wide, a longitudinal tension of 81 dynes has been measured at ordinary temperatures, and there is a definite tension for each temperature.) This tension of the surface film is one of its most commonly known properties, but some other interesting points about it are given in the following:

Its thickness, varying with temperature and other conditions, has been estimated[10] to be all the way from 4×10^{-5} to 10^{-8} cm. Its density averages 2.14 as compared with 1 for bulk water, although it is doubtless more dense at the immediate surface next to the air and gradually shades off into that of bulk water. This consideration probably explains the wide variation in the results of the measurement of the thickness, as one method might be less delicate than another and hence not take account of some of the layers of the film that are nearly bulk water in their properties. This average density, however, is illustrative of the magnitude of the force involved because water is a substance that resists compression, and it has been calculated from the known compressibility of water that the force necessary to compress it to twice its ordinary density is some thousands of atmospheres. Such a compression should liberate heat, and, in fact, the heat liberated when a definite area of new surface film is formed has been measured and found[11] to be 0.00315 cal. per sq. cm. Being so highly compressed, its specific heat might be expected to be different from that of bulk water and has been measured as being nearly 0.45 instead of 1. This low specific heat approximates that of ice.

One important property of this film is that it will often take up dissolved substances in different proportion from the amounts in which they are taken up in the bulk solution, and there is always a definite equilibrium between the two. This is known as surface concentration or 'surface adsorption,' and has been dealt with mostly in colloid chemistry, where the large amount of surface of the finely divided solids is large in comparison with their weight. In case a greater proportion of the substance is concentrated into the film than there is into the bulk water we have positive adsorption; and in the reverse case, negative adsorption. The properties of these inter-facial films have been found to be greatly modified by small amounts of dissolved substances and the properties of colloids are hence likewise greatly changed. The importance of the study of inter-facial films becomes obvious.

[7] M. & S. P., page 167, Sept. 11, 1915.
[8] H. L. Sulman, Trans. Inst. M. & M., 1912.
[9] 'A Theory of Flotation,' *Metall und Erz*, 11:455, 1914.
[10] *Philosophical Magazine*, 20:502, 1910.
[11] *Ibid.*, 20:502, 1910.

Finally, there is a most important fact about the film of water in contact with air. It has been found that there is a difference of potential of 0.055 volts between the two surfaces of the film.[12] The density of the static electric charge at this potential is 4×10^{-5} coulombs per sq. cm. This electric charge is markedly influenced by electrolytes in solution and can be increased or decreased, even passing through zero and then increasing in the opposite sign. All inter-facial films have likewise been found to be charged in one way or other. Industrial applications of this fact are legion. All the technical handling of clays is now conditioned by the use of electrolytes in this manner, and the question of emulsions of all kinds of oils in water is closely bound up with it. Cottrell's precipitation process of suspended particles of solids or liquids in gases does not escape these considerations. Small particles of solids, liquids, or gases suspended in either liquid or gaseous media are found commonly to carry electric charges, due to various combina-

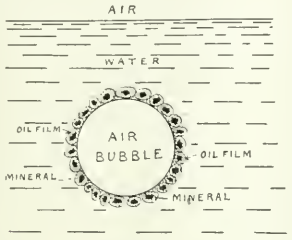


Fig. 4.

tions of factors which affect the double electric layer of the inter-facial films.

Since the size of many of the particles of minerals treated by flotation is of the same magnitude as that of many colloids we cannot escape from calling ore-slime "coarse suspension colloids," and must apply all the laws of colloid chemistry to our problem.

The electric charges on suspended particles allow another possible explanation of flotation phenomena. We find in some of the colloid chemical literature[13] that quartz particles when suspended in water are negatively charged, pyrite particles positively charged,[14] oil droplets are negatively charged, and air bubbles negatively charged.[15] The charges are somewhat small compared with the weight of the particles, so that they are hardly strong enough to cause negatively-charged quartz to stick to positively-charged pyrite, as they can have only a few points of contact, and currents in the water could easily tear them apart. However, the negatively-charged droplet of oil, which is repelled from a negatively-charged particle of quartz, can wrap itself around the positively-charged pyrite particle so that they will stick together, and the same applies to air bubbles. The other sulphides known to be flotative have positive charges when suspended in water or can be made to assume positive charges by the use of the proper amount of the proper electrolyte. So it can be seen that the application of these principles gives no difficulty in explaining flotation from an entirely new standpoint.* The large effect of a small amount of sulphuric acid on the conditions of flotation does not seem strange at all in this light, and we do not have to retreat to the purely imaginary supposition that osmotic pressure is acting through the surface of the mineral, as does Mr. Durell.

The inter-facial tension and the charge on the inter-facial film are two different physical properties of one and the same thing. I have shown that an appeal to either property is enough to build up a working picture of flotation phenomena that is simpler and more probable than that of Mr. Durell. I do not know how much there is in his contention that air bubbles will not attach themselves directly to the particles, or that only the dissolved air can thus attach itself; it may be that this is all correct, without interfering with the explanation that I have put forward. However, I hesitate to accept such a con-

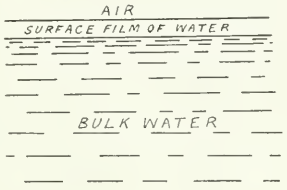


Fig. 5.

ception. The underlying cause of the tensions and of the electric charges is the same thing—some strange molecular, atomic, or other force manifested in 'adhesion,' 'cohesion,' or even 'gravitation,' if you please. No one can claim that electric charges carry the whole explanation of flotation, nor can it be stated that it is merely a question of a balancing of inter-facial tensions. Both will doubtless have to be considered.

Although much more could be said on the subject, I have only attempted to point out that there are certain scientific principles that can be applied to our problem, with great chances of success, in bringing us nearer to a definite understanding of flotation. Physical chemistry has been a recognized tool of metallurgists for some time, although little used by most of them, and now a particular branch of physical chemistry—colloid chemistry—is beckoning to us alluringly. All questions of the treatment of ore-slime should be studied in this new light. The results of an application of this idea in our own laboratory have been astonishing, and we hope that we may soon be able to publish them.

[12] *Ibid.*, 27:297, 1914, and 28:367, 1914.

[13] *Kolloid Chemische Beihefte*, 2:84.

[14] *Zeitschrift für physikalische Chemie*, 89:91, 1914.

[15] See foot-note No. 10.

* It would appear that at the instigation of J. M. Callow, the Mellon Institute of Pittsburg, under the direction of R. C. Bacon, also formulated this same theory, and for a long time has done research work in this direction, this work and continuation of it at the Bureau of Mines at Salt Lake City seem to support the logic of this theory. A paper on the same subject was read by Mr. Callow at the October meeting of the American Institute of Mining Engineers in Salt Lake City.

Assayers and Their Ways

By G. L. SHELDON

While, as in all lines of business, the great majority of men engaged in assaying are honest, there are some black sheep even among them. Once, in Mexico, I spent nearly a month's time and $100 for assays while sampling a large mass of silicified porphyry. The samples were sent to a competent American assayer, who reported $1 to $5 in gold and silver. Later, when 10 general samples were sent to good assayers in the United States and checked, I obtained an average of 30c. It proved that the first man had left too much to his Mexican helper.

Again, in a lot of 30 to 40 samples, one from a 12-ft. vein returned 76 oz. silver. The remainder were all reported low. In writing to a friend in the United States I mentioned the matter. He immediately wired back a cash offer for an interest in the property. This was accepted, the claim located, and some work was done upon it. In the course of this work it was found that in the horn-spoon what appeared to be silver always appeared in fair amount. Several Mexicans, one an old man of large experience and a particularly good judge of ores, all agreed as to the silver. It, however, eventually proved to be a sulphide of zinc in a much decomposed and oxidized condition disseminated through the ore. Of many samples checked in the United States, none showed over 8 or 10 oz. silver and $5 to $6 gold. I even sent the assayer's affidavit of certificate of the 76 oz. to my friend, but I lost his confidence just the same. The prospect is open to location today.

I once received a $600 gold assay, from a 2-ft. porphyry vein, the sample being taken from the surface. I had the utmost confidence in the assayer, but I went and re-sampled the vein, cautioning him to use the utmost care in his work, and as a result received only a return of a few dollars. The sample must have been salted by the carelessness of the helper in not properly cleaning the bucking-board.

I have known assayers, not familiar with the kind of ore represented by a sample, to throw it out and give the prospector a certificate of a few dollars' gold. The discovery-hole dug during location work yielded ore that averaged 8 to 10 oz. gold per ton for the shipment. That was 20 years ago. The mine is still shipping and paying dividends, but the poor prospector lost his opportunity because of the dishonesty of the assayer.

The discoverer of the original vein in what is now a prominent producing district in the West gave an assayer a sample, promising him an interest in the claim if the sample was any good. When the assayer came to run it, he saw only white, apparently barren, quartz. It looked no good to him and he threw it out. The prospector, not being satisfied, took another sample and gave it to a different assayer. This one found the ore to be of high value. The first assayer, hearing of this, dug up his sample from the pile of discarded rubbish and ran it. Then he tried to locate the ground, but could not find the right place.

A prospector, returning to Seattle late in the fall from Alaska, gave an assayer there a sample that showed much gold. During the winter the assayer obtained the confidence of the prospector to such an extent that he learned where the sample came from, the two agreeing to locate the ground in the spring. But the assayer could not play fair. He took a friend with him and sailed on an early boat, determined to locate the ground and defraud the prospector. Fortunately for the latter, owing to the snow, the assayer was unable to find the place. Later the prospector located the ground, and the assayer, who was still in the neighborhood, lost his time and money.

Assaying is largely a matter of care, not allowing a sample to become salted, or changed. Honesty, of course, is absolutely necessary. From rather wide experience I have adopted the plan, so far as possible, of testing for gold and silver in the field in the horn-spoon. In the case of sulphide ore it is first necessary to roast. Of any sample showing enough to warrant assaying, one-half is sent to some assayer bearing a good reputation among mining men. If a good return is made, the remaining half of the original sample is again divided into two parts. One of these is sent to an assayer that I know by experience plays the game square. I retain one sample for any necessary check. In this manner I avoid the chance of losing any more good friends through poor assays.

Coal Mining Employs Many Men

The number of men employed in the coal mines of the United States in 1914 was 763,185, of whom 179,679 were engaged in mining anthracite and 583,506 in mining bituminous coal and lignite. The average number of days of employment of each man was 207, 195 for bituminous and lignite, and 245 for anthracite, according to the U. S. Geological Survey. In the bituminous mines the yearly average decreased from 837 tons in 1913 to 724 tons in 1914. The daily average increased from 3.61 to 3.71 tons. The average time made at the anthracite mines in 1914 was exceeded only by the records of 1911 (246 days) and 1913 (257 days). The average yearly production of anthracite by each employee decreased from 520 short tons in 1913 to 505 tons in 1914, owing to the fewer days worked. The daily output per man was 2.06 tons, a slight gain compared with 2.02 tons in 1913.

An oil-mill and machinery firm at Hull, in England, has a 'private picture palace' for showing its machinery in operation under various circumstances. An interesting variation is to send the films abroad, with or without a salesman, for the benefit of customers who might never have an opportunity to see the actual operation of the machinery in other countries.

Panama Canal now employs 21,677 men.

Hoisting-Works in the Park City District, Utah—II

By L. O. HOWARD

When in the course of mining the deeper orebodies, it became necessary for the Silver King Coalition Mines Co. to have one of its main working-points 1600 ft. below the surface of Silver Hill, it was decided to install a complete plant underground. The collar of the Silver Hill winze is so far below the surface that the necessary raising to reach the surface, and the unsuitable nature of the site for a surface-plant, were important factors in the decision. An outlet was already available through connections horizontally with the 500-ft. station of the King shaft, the main working-shaft of the company. Near this shaft are the main portions of the plant, as well as the mill, and the terminus of the aerial tramway connecting the mine with the railroad at Park City. There was another outlet through the Allianee adit, the portal of which is 8500 ft. from the Silver Hill winze in a different canyon from the King shaft. At this point are some minor units of plant, such as compressor, shops, store-houses, and timber-yard.

It was estimated that the Weber quartzite, just above the contact of which with the Park City formation the best ore has been found, was 1000 to 1200 ft. below the collar of the winze, and that a short drift to the north would cut the famous Crescent fissure at a greater depth than had yet been attained. A careful study of the mine had indicated that this portion of the property was destined to be very productive, so there was no hesitation in making the winze a centre of operations, and installing equipment of a magnitude equaled by but few of the mines in Utah.

The hoist was designed for lifting a working-load of 14,100 pounds in balance, from a depth of 1300 ft. This load is made up of 4800 lb. for two double-deck cages, 1800 lb. for rope, 1500 lb. for cars, and 6000 lb. for ore. The winze has two hoisting compartments, 4½ by 5 ft., and a pump- and man-way, 4 by 5 ft., and is timbered with 10 by 10s. The head-frame is of steel, and is set on high concrete piers. The principal dimensions are: height from foundation to centre of sheaves, 32½ ft.; width of tower, 28 ft.; spread of tower, 25 ft.; diameter of sheave, 6 ft.; diameter of auxiliary man-cage sheave, 31 in.; distance from centre of shaft to centre of hoist-reels, 43 ft. 9 inches.

The hoist is a Wellman-Seaver-Morgan, electrically driven, first motion, double-reel type. The motor is direct-connected by a solid coupling, and delivers 200 hp. at 65 r.p.m. Direct-current is supplied at 600 volts by a motor-generator set. Part of the specifications follow:

Outside diameter of reel, 10 ft. 6 in.

Inside diameter of reel, 3 ft. 6 in.

Capacity of reel, 1900 ft. of 4½ by ⅝ in. flat rope.

Diameter of shaft through bearings, 10 in.

Diameter of shaft through reels and clutches, 12 in.

Size of bearings, 10 by 12 in.

Clutches are Webster, Camp & Lane, friction type, 6 ft. diameter.

Brakes, parallel acting post type.

Diameter of brake-rings, 8 ft.

Brake and clutches actuated by weights released by air.

Indicator, ordinary gear-driven dial type.

The motor-generator set takes current at 2200 volts, 60 cycles, with a rated continuous input of 250 kva. The

PART OF HEAD-FRAME IN UNDERGROUND STATION.

generator is a commutating-pole, 600-volt, direct-current type, of 165 kw. capacity.

An automatic starting-panel is so arranged that the motor can be started by a push-button. Exciting current for the synchronous motor, generator, and hoist motor is furnished by a 15-kw. motor-generator set. The motor of this set takes current at 220 volts, 3-phase, 60-cycle, and the generator delivers direct current at 125 volts. Current for the exciter set and lighting the station is furnished by two 2200 to 110/220-volt transformers of 10 kva. capacity.

The hoist-motor has a pulley for driving a Sullivan WJ-3, 11 by 11 by 14, angle-compound compressor,

compressing to 27 lb. per sq. in. within the horizontal cylinder and to 100 lb. per sq. in. within the vertical high-pressure cylinder. Air-displacement at 215 r.p.m. is 887 cu. ft. per minute. The compressor and the hoist are so interlocked that when the hoist is started the compressor is unloaded and runs at no load during the hoisting period.

At the portal of the Alliance adit is a transformer-station taking power at 11,000 volts from the lines of the Utah Power & Light Co., and delivering current to the feed-cables at 2300 volts. The transformer-station is 20 by 25 ft. with concrete walls and corrugated-iron roof. In it are housed transformers of 600 kva. capacity. To take the current underground 10,000 ft. of cable is required. It is made up of three copper conductors, 2/0 Brown & Sharpe standard. Each conductor is insulated with 5/64 in. of varnished cambric. The conductors are insulated from the lead sheath by 1/16 in. of the same material. The lead sheath is 3/32 in. thick, and covered with 0.15 in. of jute, two layers of steel-band armor, and another 0.15-in. layer of jute. The diameter is 2.55 in., and the weight, 6⅔ lb. per foot. All joints are made by means of pot-heads.

This careful insulation was made necessary by the high voltage at which the current was carried underground, and the severe service conditions. The cable was laid along the bottom of the adit near one side and covered with light boards.

The hoisting equipment is placed in one room and the compressor, switchboards, and exciter set in an adjoining room, separated from the hoist-room by a 4-ft. reinforced-concrete wall. Both rooms have arched roofs. The span of the hoist-room roof is 35 ft. At the back it is 12½ ft. high, gradually rising toward the shaft 1½ ft. in 5. The compressor-room is 42 by 30 ft. and 20 ft. high, with an elliptical roof-arch having its major axis horizontal. Old 56-lb. rails, bent to the same arc as the arch, are imbedded in concrete at intervals of 2½ ft. Old 4-in. boiler-flues were placed above the rails. Where the back was strong enough, the rails were slung in loops of old cable hung in eye-bolts. Two 20-in. I-beams, laid side by side, and cut 50 ft. long to give good bearings in solid rock, support the crown of the arch. As a centre-support for the I-beams there was erected an extra-heavy 12-in. iron column filled with cement. All the walls of the rooms are 4 to 5 ft. thick, of heavily reinforced-concrete. In cutting the station great care was necessary. The lime proved heavier than anticipated. A fault passed between the two rooms, making very heavy ground.

In excavating for the rooms a slice was first taken for the width of the room and one set high, and timbered with square sets. Ten by ten timbers, cut and framed so as to be available in the shaft later, were used. Excavation proceeded by raising and taking a second slice, then a third. Posts resting on the square sets supported the back. Tailing from the mill was brought in mine-cars to the King shaft, lowered to the 500-ft. level and trammed to the station. Rock was prepared from the excavated material by crushing in a Dodge breaker and screening. In the hoist-room, which was completed last, the concrete mixer was placed at the top of the room and the concrete chuted to the forms. A 1:2½:5 mixture was used.

A short distance from the station the haulage-way is three tracks wide, providing room for storage of empties and loaded cars, and switching. The station may be approached from either side, by means of a loop. Blacksmith-shop and drill-sharpener have also been placed at the station.

Ore and waste are hoisted through the Silver Hill winze in skips and dumped into pockets in the head-frame. From this cars are loaded with waste to be hauled out through the Alliance adit to the waste-dump. Ore is hauled to the 500-ft. level of the King shaft, hoisted on cages to the surface, and trammed, if first-class, to the upper terminus of the aerial tramway through the sampler. Second-class ore is hauled directly to the mill.

The Silver Hill station is well lighted and ventilated. The photographs accompanying this article were taken with the ordinary lighting of the station. The work of cutting the station and installing the equipment was done under the direction of James Hume, superintendent, and James Toole, master-mechanic. The station was dedicated by a party of directors and stockholders in April 1914.

There are two main openings to the Daly-Judge mine, the Anchor tunnel, and the Anchor shaft. The portal of the adit is at the bottom of Empire canyon, about a quarter of a mile above the company's mill, and one mile from Park City, or midway between Park City and the Daly West mine. It is the main entry; men and supplies are hauled in through it, and the ore and waste taken out through it. It is driven 6625 ft. in a straight line to the 1200-ft. level of the Anchor shaft, the collar of which is well up the canyon. Electric haulage is used.

The Anchor shaft has a depth of 1600 ft. It has two 4½ by 5-ft. compartments, with a small pump and manway. Ten-by-ten timbers are used throughout. Hoisting and lowering to the 1200-ft. level is done by a flat-rope and reel-hoist, placed on the surface. The hoisting engine is a 20 by 60-in. Bullock first-motion duplex. The rope is ½ by 5 in. The reels have a maximum diameter of 12 ft. The head-frame is of wood, 60 ft. high.

A Nordberg 16½ by 28 in. by 36 in. two-stage compressor with a displacement of 2100 cu. ft., compressing to 100 lb. per sq. in., is rope-driven by a 350-hp. General Electric induction motor, taking current at 440 volts, through a transformer-station that receives current at 6600 volts.

The probably long life of the mine warrants new equipment, as the old has seen many years of service. Plans for a new head-frame and hoist are practically complete. The new head-frame will be of steel, 70 ft. high. The width of the tower will be 36 ft. and the spread 50 ft. The distance from the centre line of the drums to the centre of shaft will be 110 ft. The diameter of the sheave will be 7 feet.

PORTAL OF ANCHOR TUNNEL, PARK CITY.

The hoist is to be an Allis-Chalmers double-reel type, electrically driven. The principal data are:

Rope-pull, 20,100 lb., made up of 2600 lb. for double-deck cage, 2300 lb. for two cars, 9200 lb. for rope, and 6000 lb. for ore.

Minimum diameter of reel, 3 feet.

Maximum diameter of reel, 13 feet.

Clutch, segmental disc type, 8 ft. diameter.

Diameter of shaft through brakes and clutches, 13 inches.

Diameter of shaft through end bearings, 10 inches.

Size of bearings, main, 13 by 20 in., end, 10 by 24 inches.

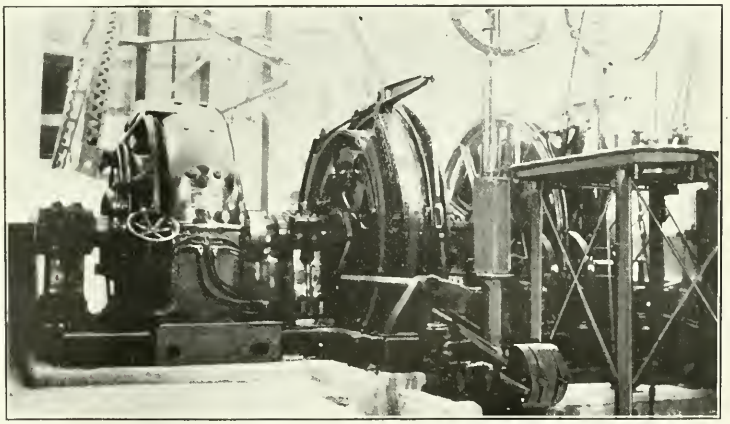
Brake, parallel acting post type.

Diameter of brake-ring, 9 feet.

Capacity of reels, 2500 ft. of $5\frac{1}{2}$ by $\frac{3}{8}$-in. rope.

Rope speed, 1500 ft. per minute.

The hoist is a second-motion type, driven through Wuest gears by an Allis-Chalmers 400-hp. slip-ring motor, taking current at 440 volts, 3-phase, 60 cycles. The motor-shaft will have a flexible coupling. Control is to be maintained by a moveable-electrode liquid-rheostat. The design involves heavy electrode plates moved in and out of the electrode by means of an oil-cylinder. All other

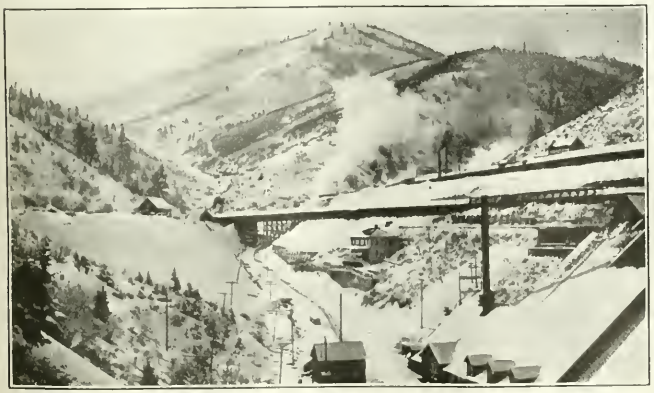


HOIST UNDERGROUND IN SILVER KING COALITION MINE.

auxiliaries are to be oil-operated. For control of the brakes there will be a duplicate oil-pump, and a dead-weight accumulator with a total reserve capable of operating one brake 20 times. The indicator will be of the compensated dial type, with $5\frac{1}{2}$-in. movement for every 100 ft. of depth. To promote safety there will be below the indicator red and green lighted arrows, which will indicate the direction of hoisting.

Considering the three hoists that I have described, it will be noted that they have many points of difference. For convenience of reference, I have grouped the principal data in the following table:

Many points of comparison are emphasized by this table; and to a few



EMPIRE CANYON, PARK CITY.

Showing Daly-Judge mill, and snow-sheds from Anchor Tunnel to waste-dump; also upper snow-shed from Alliance Tunnel of Silver King Coalition.

of these I would call attention. The most interesting is the difference in control. At the Silver King Coalition, the control is electrical, and this hoist has been operated out of balance, hoisting ore in one skip, without use of the brakes for days at a time, which speaks volumes for the efficacy of the control. The fixed electrode liquid rheostat is standard for large hoists, and it will be interesting to note the result of the application of the movable electrode rheostat. The Silver King hoist also illustrates a type of plant wherein an attempt is made to avoid high peaks. The advantages are obvious. For hoisting large loads from greater depths, second-motion hoists are favored. Reel and flat rope hoists continue the favorites in this district as well as in the rest of the State; the advantages of shorter shaft, better balancing of loads, etc., have justified its use here. However, we find one company abandoning the use of it in favor of the cheaper first cost, and generally longer wear of rope, of the drum type.

The three installations add further emphasis to the steady supersession of steam by electricity, since the problems of control have been solved.

	Silver King Coalition.	Daly West.	Daly-Judge.
Type of Hoist	Wellman-Seaver-Morgan double reel and flat rope, first motion.	Wellman-Seaver-Morgan double drum, second motion.	Allis-Chalmers double reel and flat rope, second motion.
Working load, pounds	14,100	15,000	20,100
Diameter of reel or drum	{ Min., 3 ft. 6 in. Max., 10 ft. 6 in.	5 ft. by 39 in. face.	{ Min., 3 ft. Max., 13 ft.
Rope-speed, feet per minute	1500	1000	1500
Size of rope, inches	4½ by ⅜	1	5½ by ⅜
Weight of ore hoisted, pounds	6000	8000	6000
Clutches	Webster, Camp & Lane, friction.	Webster, Camp & Lane, friction.	Segmental disc.
Diam. of shaft through clutch and reel, inches.	12	8	13
Same through end bearings, inches	10	8	10
Diameter of brake-ring, inches	96	80	108
Brake and clutches actuated by	Air.	Air.	Oil.
Motor	General Electric, direct current, 125 volts.	Westinghouse, type C1, 2200 v., 3 ph., 60 cycles.	Allis-Chalmers, 440 v., 3 ph., 60 cycles.
Motor-speed, r.p.m.	65	500	575
Horse-power	200	300	400
Control	Electric.	Liquid rheostat, fixed plates.	Liquid rheostat, movable plates.
Depth of ultimate hoisting, feet	1300	2400	2500
Ore hoisted in	Skips.	Skips.	Cars on cages.

The Standard of Value. The transactions of the civilized world are based on gold. It is, however, far from an ideal standard of value. In the first place, the supply is too variable. From 1800 to 1850 the annual output was around $10,000,000; by 1895 the production had increased 20-fold to $200,000,000 yearly, and in 1913 the maximum output of over $463,000,000 was attained. The consensus of opinion among well informed engineers is that the production of gold will decrease materially within the next twenty years, but it seems likely that the business of the world will continue to augment for centuries. Hence, the supply of gold, the standard of value, bears no relation to the amount of work it will have to do. This lack of relation between the volume of the world's trade and the production of gold must have a potent influence on prices, although economists differ as to the exact effect. The reason for this difference of opinion is that the influence of the varying gold production has been obscured by changes in the methods of financing trade operations, for example, by the greater use of checks, drafts, telegraphic transfers, and other forms of paper money. Another obscuring cause is the reduction in costs due to improved methods of manufacture, an excellent example of such reduction being afforded in electric lighting. On the other hand, the failure of producers to increase the supply of their commodities with the increased demand tends to raise prices; this effect is plainly seen in the cattle-raising industry of the United States, where the increase of population of 10,000,000 (1910-1914) has been accompanied by a decreas of 10,000,000 in the number of cattle; this shortage has naturally increased the price of meat. Therefore, although prices have advanced as a whole it is impossible to prove that the increased production of gold has raised the general price-level. Until within a few months, the universally accepted theory was that the more gold a nation has the better its financial position. Today we find a new doctrine in vogue and see the leading financiers of the United States trying to stop the influx of gold from Europe. They fear that a superabundance of gold in the vaults of our banks will lead to wild speculation. Possibly in the dim future men will be sensible enough to evolve some better standard of values than that of a metal produced so unevenly and so dangerous both to him who has too little and to him who has too much—nations as well as persons.

Mulga, a hardwood of the Western Australian goldfields, has a calorific value of 7000 B.T.U., against 14,000 B.T.U. in good bituminous coal.

The Geology of Iron Mountain

By OSCAR H. HERSHEY

Introduction. The present writer is the geological member of the engineering firm that holds the position of consulting engineers to the Mountain Copper Company, Ltd. This company operates a group of mines at and near Iron Mountain in the 'copper belt' of Shasta county, California. On my periodic visits to the mines, I have made a surface geological map of about 1.2 square miles on a scale of 100 ft. to the inch. It is based on a good topographical map that was made by E. L. Stenger, a former mine-surveyor. This map has 25-ft. contours, and indicates the position of houses, roads, tunnels, triangulation stations, and diamond-drill holes, to which the geologic boundaries have been tied. Beyond the contours I made a rough compass and pacing survey. In preparing the reduced-scale map to accompany this paper I have had to sacrifice most of the cultural features and have used the 100-ft. contours only.

The large scale of the map permitted working out the geology in a detailed manner that has, so far as I am aware, never before been attempted in any portion of the Shasta copper belt west of the Sacramento river. J. S. Diller, in preparing the Redding folio of the Geologic Atlas of the United States, working on a scale of 2 miles per inch, found it necessary to greatly generalize the mapping of the acid rocks of the copper belt. At a later date a special study of the belt was made for the U. S. Geological Survey by L. C. Graton, assisted by B. S. Butler[1]. They used a larger-scale map, but not one that would admit of the detail of my Iron Mountain map. Without intending criticism of the work of the Federal geologists, I may be permitted to suggest that their treatment, by force of unavoidable circumstances, of the alaskitic rocks of the copper belt as largely a single intrusive mass instead of a complex of relatively small intrusive bodies has led to some erroneous conclusions, or rather to an avoidance of some obvious conclusions, regarding the relation between the structure of the rocks and the form and distribution of the mineral deposits.

As Mr. Diller had made an elaborate microscopical study of the Shasta rocks, I submitted to him a small set of thin sections from diamond-drill cores at Iron Mountain. These were studied by his assistant, H. G. Ferguson, who kindly furnished me notes on the petrography, the substance of which I shall use in this paper. I may say that this paper is published at the request of Mr. Diller and with the permission of the board of directors of the Mountain Copper Company. A comprehensive discussion of the mineral deposits would be premature as I have not come to a definite conclusion in regard to the source of the mineralizing solutions, but I can go into the subject sufficiently to make this paper proper for a mining journal and of general interest to those living in the copper belt.

Copley Formation. The oldest formation exposed within the limits of my Iron Mountain map is the Copley meta-andesite. The age is not definitely known except that it is younger than certain Archean schists and older than the Kennett formation of Devonian age. The formation originally consisted of a thick series of lava-sheets and tuffs, chiefly of pyroxene-andesite. My early studies of the formation were confined to an extensive area west of the copper belt, from which I described it in 1901 under the term Clear Creek greenstone[2]. I referred to it as diabase, deriving the term from its early application by the U. S. Geological Survey to similar rocks in the Sierra Nevada region. Mr. Diller studied it near the Sacramento river, and for its petrography the reader is referred to his discussion in the Redding folio, published in 1906. In the Iron Mountain region I recognize three members. They remain in fragments only, but if the alaskitic intrusions had not occurred, the area would be crossed by three meta-andesite belts trending in a north-east direction. The south-east portion would be underlain by a broad belt of compact fine-grained meta-andesite lava. This would be followed, going north-west, by a relatively narrow belt of amygdaloidal lava. The remainder of the area would be included in a broad belt of coarse volcanic agglomerate. The latter is made up of rounded fragments of meta-andesite, in large part amygdaloidal, that have been cemented into a hard rock. The three members have been tilted to a nearly vertical position. This fact has had an important influence on subsequent structural features of the district, even to the distribution of the sulphide orebodies. The alaskitic intrusions tended to follow the strike and dip of the beds of the andesite series and thus acquired the north-east elongation which a glance at the map shows to be characteristic of the district. The Copley fragments retain, in a general way, their original attitude.

Bragdon Formation. On the north-west border of the map there is a small area of gray hard shale that weathers light-brown and pink. This is an outlier of a large area of the Bragdon formation that lies north-west of Iron Mountain and consists of conglomerates, sandstones, carbonaceous slates, and shales. In my early work on this formation I placed it in the Jurassic group, but in recent years the Geological Survey, on the basis of some obscure fossil localities, has classed it as early Carboniferous. In places it rests unconformably on the Kennett shales and limestones and its conglomerates con-

[1] 'The Occurrence of Copper in Shasta County, California,' by L. C. Graton, Bull. 430-B, U. S. Geol. Surv., 1910.

[2] 'Metamorphic Formations of Northwestern California,' *American Geologist*, April, 1901.

tain limestone pebbles with Devonian fossils. In other places, as in the extensive area discussed in my 1901 paper, it rests unconformably on the Copley series. That was probably the case in our Iron Mountain area, over all of which it extended in a thick series probably laid down after the meta-andesite had been tilted to a nearly vertical position and eroded to a plain. Here we have another fact that influenced subsequent structures. The main alaskite porphyry intrusion arose nearly vertically along the structure-planes of the meta-andesite and tended to spread out in laccolithic form under the Bragdon shale. The shale fragment remaining in the area is surrounded and intruded by dikes of this porphyry.

It dips south-east 25° and as the porphyry rises much higher in the direction of dip, without faulting, this is evidently a mass of shale that sank into the magma or projected down from the shale roof. That a portion of the porphyry intrusion of the copper belt in general approaches toward laccolithic conditions was noted by Mr. Graton.

Alaskite. In the Redding folio Mr. Diller mapped the acidic intrusives in the copper belt west of the Sacramento river mainly under one formation, the Balaklala rhyolite. At a later date Mr. Graton pronounced the Balaklala formation an alaskite-porphyry. Early in my work at Iron Mountain I became convinced that the products of several distinct stages of intrusion have been included under the name Balaklala. It is true that Mr. Diller excluded some dikes west of the Sacramento river as probably of later age, but even so recently as May of this year, the copper belt is mapped as comprised in one unbroken area of alaskite-porphyry.[3] However, Mr. Ferguson's work on the thin sections has demonstrated that there is at Iron Mountain a fine-grained, non-porphyritic alaskite that occurs in fairly large masses rather than in dike form. The rock is composed of a mass of interlocking grains of quartz and feldspar, small irregular patches of secondary chlorite, and, in places, a little sericite. The feldspar is usually albite. There are no phenocrysts in the thin sections. The grains vary from 0.06 to about 0.15 mm. in diameter. To the unaided eye, much of the rock has the appearance of a fine-grained white or pale greenish quartzite. When fresh it is very hard and it appears in the old diamond-drill records largely as 'felsite.'

In certain areas the alaskite formation is a breccia made up of acid fragments of varying texture, although most of them seem to be alaskite of the same variety as the large compact masses. Some areas consist exclusively of this breccia; some are made up of large masses of compact alaskite surrounded by the breccia; in others the breccia grades, along a fairly sharp line, into the main bodies of the alaskite; and, finally, there are places where the latter has a vaguely brecciated appearance on weathered surfaces, which disappears underground. The alaskite-breccia presents the same intrusive relation to the meta-andesite as does the compact alaskite; hence it cannot be looked upon as a surface phase. The explanation that suggests itself is that after the alaskite had solidified, certain portions were broken into fragments, partly fused and became embedded in an alaskite paste. The more prominent areas of breccia I have mapped separate from the remainder of the alaskite. Their rather rounded outlines suggest volcanic necks.

In the Iron Mountain area, the alaskite was intruded into the meta-andesite series in a broad belt with a northeast course. In this belt, the basic rocks in part remained in isolated, rather large inclusions, in a large measure retaining their original orientation. On both sides of the main belt, arms and small irregular areas of alaskite penetrate the meta-andesite. The intrusive relation between these formations is beyond question. The relation between the Bragdon shale and the alaskite is not known. Presumably the alaskite, like the alaskite-porphyry of the third series, is younger than the Bragdon formation, but of this there is no definite evidence. It is quite clear from the map that the alaskite represents an intrusion distinctly earlier than the alaskite-porphyry intrusions, but how much earlier we do not know. Mr. Ferguson takes the position[4] that the alaskite may be merely a fine-grained phase of the alaskite-porphyry intrusion, perhaps a slightly earlier and more quickly chilled portion of the intrusion. A somewhat similar idea must have been entertained by the other geologists who have studied the Shasta copper belt and made no attempt to separate the alaskitic phases. But upon my mapping a small portion of the belt on a much larger scale than anyone else has used, it becomes clear that the non-porphyritic alaskite represents a distinct and separate intrusion. This is proved by sharp contacts, by dikes of alaskite-porphyry cutting alaskite, by the presence of large angular inclusions of alaskite in the main porphyry mass and by the fact that a certain block of alaskite-porphyry, indicated on the map by dots added to the convention for the third series, abounds in angular and subangular small inclusions of alaskite. I regard the alaskite as representing an early stage of the same magma as the alaskite-porphyries.

Alaskite-Porphyry, First Series. Under this heading I include certain obscurely porphyritic dikes, with small, not very plentiful, quartz phenocrysts. These dikes are white, both when fresh and on weathered surfaces. In a few places the alaskite formation becomes faintly porphyritic and then some question arises as to whether it may not grade into this first series of porphyry dikes. Usually they are quite distinct. For instance, above the rock-quarry beside Slick Rock creek, a branched dike of obscurely porphyritic material has been intruded into the alaskite-breccia. Most of the dikes of this series occur chiefly in the meta-andesite lava in the south-eastern portion of the area mapped. The largest one, bordering on the quartz-diorite series, is about one-half mile long and over 300 ft. in maximum width. These dikes rarely meet the more coarsely porphyritic dikes, but as both types of rock occur in dikes of similar sizes in the same area, their

[3]'Pocket Deposits of the Klamath Mountains, California,' by H. G. Ferguson, *Economic Geology*, Vol. X, No. 3, April-May, 1915.

[4]Communicated.

differences cannot be attributed to the more rapid chilling of certain members of the same system.

Alaskite Porphyry. Second Series. These dikes vary from white to yellow where they outcrop and usually are strongly porphyritic, abounding in quartz phenocrysts varying from medium to large size. Petrographically they do not differ materially from the alaskite-porphyry dikes of the third series and I would be unable to separate them if it were not that they are cut by the so-called inter-porphyry breccia, whereas the third series dikes are younger than that breccia. Hence, I am able to map them in the vicinity of the breccia belts only.

Inter-Porphyry Breccia. Crossing the area mapped there is a peculiar zone of breccia consisting of angular and subangular fragments of meta-andesite, alaskite, and the obscurely porphyritic alaskite-porphyry; also of some coarse porphyry in the vicinity of certain dikes of the second series. It varies in width from a few feet to over 500 ft. and toward the north-east branches into two roughly parallel belts. As might be expected from its composition, it cuts through the obscurely porphyritic dikes it encounters and many of the coarsely porphyritic dikes. I have found two masses of coarsely porphyritic alaskite-porphyry that seem to have been intruded into it and one dike that seems to go through it. It is a little difficult to understand the conditions under which this breccia was formed. It occupies a fissure of greatly varying width along whose walls there has been no differential displacement; hence it is not a fault-breccia. Probably it is of the nature of certain breccia-filled fissures that may be found around the base of many volcanoes.

Alaskite-Porphyry. Third Series. The main mass of alaskite-porphyry, as determined by Mr. Ferguson, has prominent rounded quartz crystals, up to 2 mm. diameter. Feldspar was formerly present in a number of rather smaller crystals, but they have been completely altered to quartz-sericite aggregates. The ground-mass is largely quartz in very minute grains, with a small amount of sericite. This porphyry has been intruded largely in the form of a huge irregular dike on the site of the main alaskite mass. It also tended, as already stated, to spread out in a laccolithic form under the Bragdon formation. In the central portion of the map the alaskite-porphyry area is broad because the exposed surface is at relatively high altitudes. In the valley of Slick Rock creek it becomes much constricted and at the even lower levels on the north-east side of Boulder creek it is largely replaced by alaskite. However, high on the mountain beyond the north-east border of the area mapped it again spreads to considerable width.

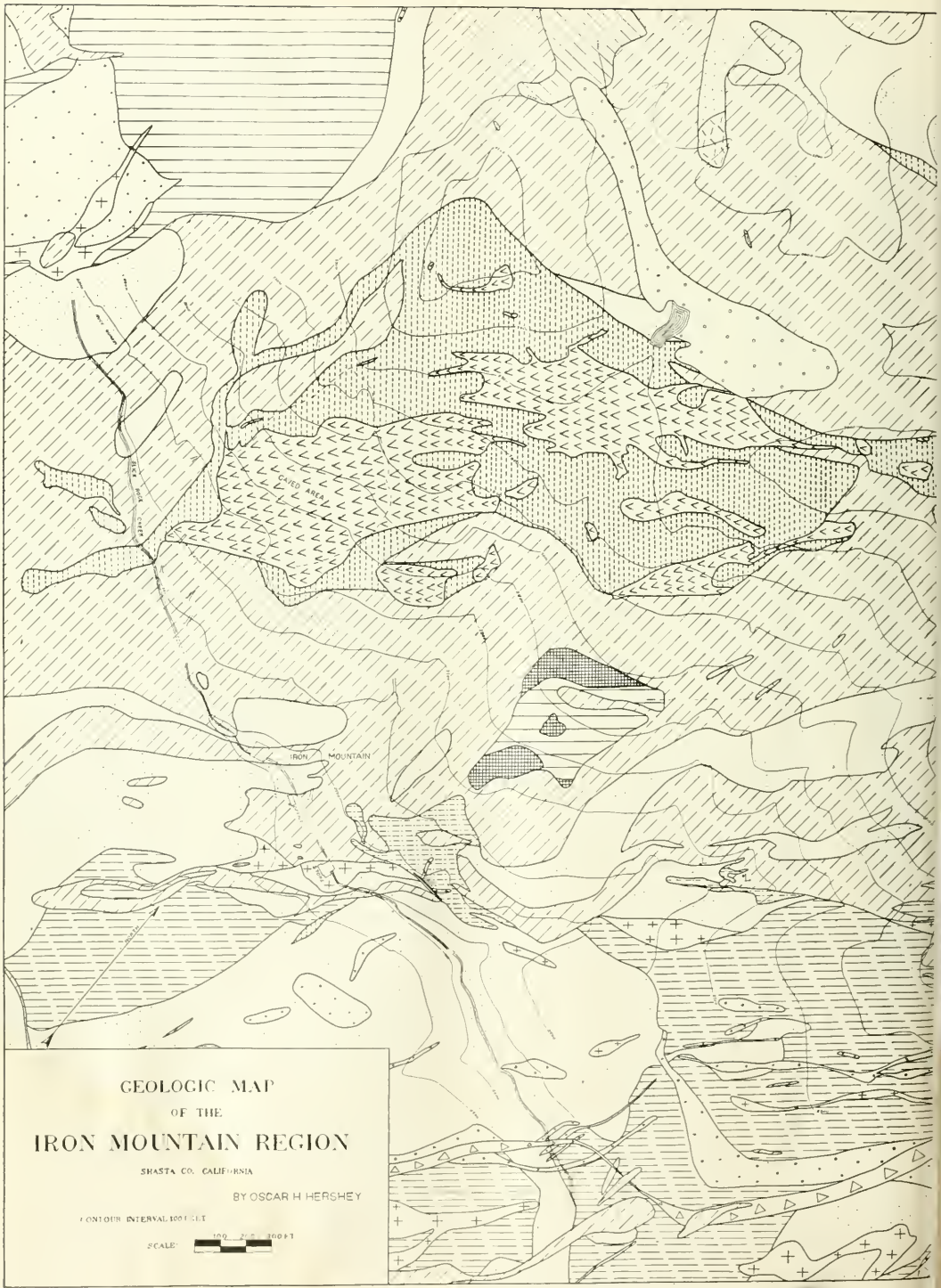
In habit of occurrence, petrographic character, and appearance on outcrop, the main alaskite-porphyry mass cannot be distinguished from the smaller bodies that have been intruded into the inter-porphyry breccia. This is my chief reason for including the large mass in the third series; at the same time I must concede that there is little to discriminate it from the second series. In the meta-andesite and alaskite on the north of the large dike there are many smaller areas of similar porphyry, all of which I have mapped in the third series because I have no means of separating them if they also include second-series dikes.

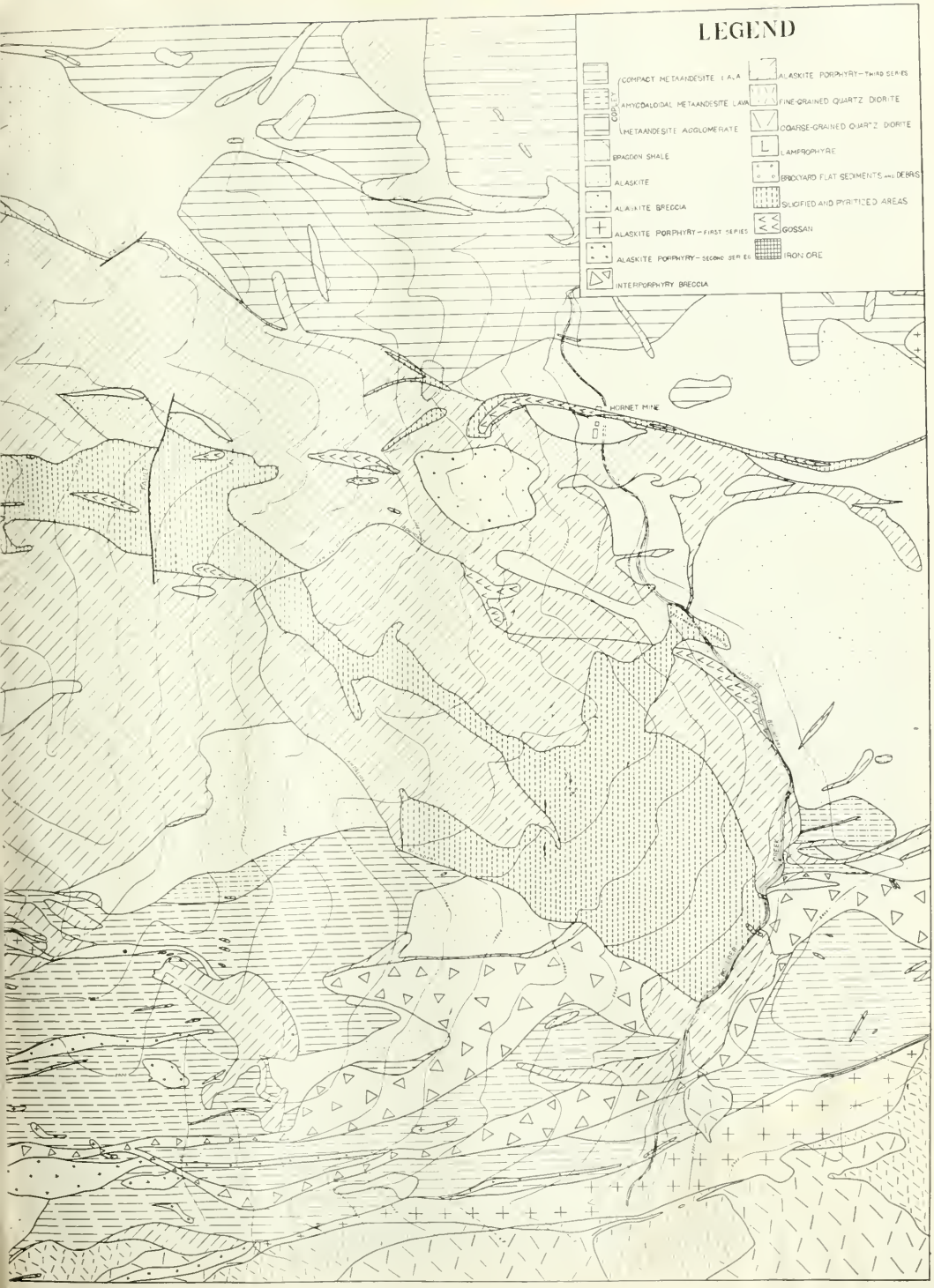
I have carried my reconnaissance surveys over enough of the copper belt beyond the Iron Mountain area to know that the same complexity of alaskitic rocks obtains practically throughout the area of what has been mapped as the Balaklala alaskite-porphyry. Instead of being one great *massif* that should, from its size, have given rise to a granitic texture in the central portions, it is made up of the products of several periods of intrusion and no one intrusion is represented by a single very large body. Probably all the intruded material came from the same deep-lying magma. At first the magma was without quartz phenocrysts and the alaskite resulted. Gradually quartz crystals formed in the magma. When they were small and not abundant, there was an intrusion that formed the porphyry dikes of the first series. Later, after the quartz crystals had grown relatively large and numerous, an important intrusion began. While it was in progress, the inter-porphyry breccia was formed, enabling me, in its vicinity, to discriminate the earlier from the later dikes of the last great intrusion.

The name Balaklala was derived from the fact that the formation to which it was desired to apply the name forms the hills about the Balaklala mine. Most of these hills are chiefly normal or third-series alaskite-porphyry. Furthermore, it has been frequently stated that the sulphide orebodies occur in the Balaklala formation. For these reasons, the name clearly should be applied to the main alaskite-porphyry intrusion. The alaskite intrusion deserves a separate name, but no suitable geographic designation has yet appeared.

In the main alaskite-porphyry mass at Iron Mountain, there are a number of large inclusions of older rocks. Some of those that I now map as alaskite I once thought were silicified portions of presumably less basic members of the Copley volcanic series, as on outcrop they more nearly resemble the meta-andesite than the normal alaskite-porphyry. However, in the progress of my detailed field-work, I learned to discriminate them with comparative ease. The important fact is that these inclusions exist and their composition is of lesser significance from an economic standpoint. Those near the Iron Mountain mine are comparatively shallow, roughly lenticular masses, dipping at low angles.

Quartz-Diorite. The quartz-diorite that appears near the north-east corner of my map is a portion of a large mass that extends nearly to Keswick and south into the valley of Clear creek. It consists mainly of feldspars that are predominantly plagioclase, a little free quartz, and some ferro-magnesian mineral, either biotite or hornblende, or both. Where it enters the north-east portion of my mapped area it can be discriminated into two phases, which I have designated respectively as the fine-grained quartz-diorite and the coarse-grained quartz-diorite. There seems little doubt that the coarse-grained has been intruded into the fine-grained. My idea is that after the fine-grained quartz-diorite had crystallized, but not entirely cooled, there was another irruption of magma from below which resulted in the coarse-grained


CAVED AREA
IRON MOUNTAIN
GEOLOGIC MAP
OF THE
IRON MOUNTAIN REGION
SHASTA CO. CALIFORNIA
BY OSCAR H HERSHEY
CONTOUR INTERVAL 100 FEET
SCALE:


LEGEND
COMPACT METAANDESITE LAVA
AMYGDALOIDAL METAANDESITE LAVA
METAANDESITE AGGLOMERATE
EPIDOTE SHALE
ALASKITE
ALASKITE BRECCIA
ALASKITE PORPHYRY—FIRST SERIES
ALASKITE PORPHYRY—SECOND SERIES
INTERPORPHYRY BRECCIA
ALASKITE PORPHYRY—THIRD SERIES
FINE-GRAINED QUARTZ DIORITE
COARSE-GRAINED QUARTZ DIORITE
LAMPROPHYRE
BROCKYARD FLAT SEDIMENTS AND DEBRIS
SILICIFIED AND PYRITICED AREAS
GOSSAN
IRON ORE
HORNET MINE

phase. Dikes of the latter cut through to the border and one small area occurs entirely beyond the fine-grained quartz-diorite, hence it is not a case of a fine-grained border produced by chilling. Small irregular dikes of the coarse-grained are common in the fine-grained, and isolated inclusions of the latter are common in the former.

There are but few dikes of quartz-diorite beyond the main mass. A short distance east of the Bragdon area and a short distance south-east of the centre of the area mapped there are three small areas of crystalline rock that weathers light-brown and resembles the fine-grained quartz-diorite, under which designation I have mapped it, although not with entire confidence.

I am inclined to consider the quartz-diorite intrusions as younger than the alaskitic intrusions. That is the opinion held by most students of the region, but I infer from a statement made in Mr. Ferguson's latest paper, cited before[5], that he places the quartz-diorite intrusions first. The fact is that the evidence is not conclusive. I have searched along the border of the quartz-diorite area without a definite result. Recently some small dikes have been found in one of the mines that not only cut the main alaskite-porphyry, presumably of the third series, but also are post-mineral. They appear to be quartz-porphyries, but when studied microscopically may prove to be related to the quartz-diorite.

Lamprophyre. In the alaskite-porphyry in the south central portion of the area mapped, there are two chimney-like masses, almost too small to map, of a dark-gray fine-grained crystalline that I am terming 'lamprophyre' in the absence of a thorough investigation.

Brickyard Flat Sediments and Debris. Behind the crest of the high mountain that lies north and north-east of the old Iron Mountain mine, there is a relatively broad shallow depression floored by debris and an occasional stream cobble, overlying sandy clay that is probably a remnant of the creek deposit of an early system of drainage that has been completely destroyed in the surrounding country, leaving this short section of old valley high on the mountain.

Silicified and Pyritized Areas. The larger portion of the main mass of alaskite-porphyry at Iron Mountain and a few of the smaller masses have acquired a schistose structure as the result of compression. A small quantity of fine-grained pyrite is widely disseminated in these sheared areas. This was deposited by water. In certain large sections, the water has largely replaced the schistose rock by quartz and pyrite. Below the zone of oxidation the rock is a fine-grained white quartz (with remnants of the original minerals) through which pyrite is distributed. The pyrite may vary from a few widely-spaced grains to a rock that is chiefly pyrite with a cement of quartz. In the zone of oxidation, the pyrite has decayed, leaving a skeleton of quartz more or less stained by limonite. This is the material that I have mapped as silicified and pyritized areas. They are chiefly confined to a broad band crossing the district in a north-east direction. They are most strongly developed in the laccolithic portion of the alaskite-porphyry and hence at high levels. The large mass that extends down to Boulder creek is not an exception, for it is in a great landslide that has carried it down from a high level. A less favorable site is at the north border of the main alaskite-porphyry mass. Rarely has the material been formed from the alaskite.

Gossan. In certain portions of the altered alaskite-porphyry the replacement by pyrite and other sulphides has proceeded to the almost entire exclusion of secondary quartz and original rock-minerals, forming the 'sulphide orebodies.' Near the surface, oxidation and leaching have converted the material into a reddish-brown porous mass of limonite, mapped as gossan. A glance at the map will give one a fair idea of the original distribution of the sulphide bodies. They were practically confined to a broad belt trending in a north-east direction. The locus of this belt was fixed by the main alaskite-porphyry intrusion, the position and shape of which were governed by the alaskite intrusion. The latter received its north-east elongation from the initial tilting of the meta-andesite series. Thus we have a clear explanation of the major control of the distribution of the sulphide orebodies in the Iron Mountain region. I believe I can safely carry the matter to a further conclusion. In his preliminary report on the copper belt, Mr. Graton stated that the principal orebodies west of the Sacramento river are mostly rather flat-lying, but he offered no satisfactory explanation, though he suggested that in the arching up of the shales of the Kennett and Bragdon formations, the cooling porphyry may have been subjected to stresses resulting in flat zones of crushing and shearing. The sulphide orebodies are roughly lenticular masses. In the Iron Mountain region some of them dip at low angles and others stand on edge. It is an odd and doubtless significant fact that the low-dipping sulphide lenses are in that portion of the main alaskite-porphyry mass characterized by shallow low-dipping inclusions of alaskite and meta-andesite, and the sulphide lenses that stand on edge are near equally steep contacts between the alaskite-porphyry and the older rocks. In other words, the stresses that resulted in lenticular bodies of fractured porphyry were governed by the local contacts, a large rigid inclusion having the same effect as the walls of the main porphyry body.

Iron Ore. Under this heading I have mapped four areas of black heavy iron ore that occurs in connection with a large inclusion of meta-andesite agglomerate. The ore has a red streak, but is magnetic, from which I infer that it is a mixture of hematite and magnetite. Smaller masses of iron ore are scattered through the agglomerate. I am inclined to regard this ore as a contact-metamorphic deposit formed in the meta-andesite by the action of the surrounding alaskite-porphyry magma. The iron may have been derived from ferro-magnesian silicates in the meta-andesite. This raises a question of sufficiency of the source as the present mass is rather limited. Perhaps the metamorphism was the result of the early or alaskite stage, the mass being subsequently engulfed in the alaskite-porphyry.

[5] *Economic Geology*, Vol. X, No. 3, p. 242.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Powdered coal burns best with 200 cu. ft. of air for each pound.

Overheating drill-steel in the blacksmith-shop destroys the carbon in the steel, rendering it useless. When this occurs the burned portion should be cut off.

Iron money, consisting of 100,000,000 5-pfennig pieces (100 pfennig = 1 mark = 25 cents U. S.) are now being circulated in Germany. They are to replace the copper and nickel coins heretofore in use.

The square-set method of mine timbering was first introduced in the Ophir mine on the Comstock Lode in 1860 by P. Deidesheimer. It has since been employed in every part of the world, many modifications of the original method being in use.

Altitude is not a factor of a gas or gasoline engine, which works equally well at high or low altitude. The engine depends upon the expansive force of the gas created by the ignition of the gas or vapor, which is entirely independent of the pressure of the atmosphere.

Extension of a crack in a sheet of metal may be stopped by drilling a hole where the crack ends. To determine this moisten the surface with petroleum, rub clean, and apply with chalk. The oil which has penetrated the finest crack, oozes out and becomes visible.

Work done within the boundaries of a patented group of mining claims in California can be applied as annual work to hold unpatented claims owned by the same people, provided the work is clearly shown to be directed toward and plainly designed to aid in developing the unpatented territory.

Use of oil for fuel for many industries on the Pacific Coast has affected coal mining in Washington and British Columbia. It is estimated that the consumption of California oil for fuel in the region is equivalent to about 21,000,000 tons of coal, or between 6 and 7 times the output of coal in Washington, or for that matter in all the Pacific Coast States combined, in 1914.

When a set of shaft-timbers is framed, it is well to fit it snugly together on the ground and bore a $\frac{3}{4}$-in. hole at each corner, penetrating both timbers. When the set is hung in the shaft, drive a wooden pin through the hole in each corner before screwing up the hangers. This will hold the set together with all joints tight, obviating the possibility of accidentally knocking an end-plate into the sump, or having to loosen the hangers because the corners opened. If the wooden-pin protrudes, the end can be broken off when ready to put in a set below. An old miner, recently questioned, did not know of this aid in hanging shaft-timbers.

The term 'coulee' is generally applied throughout the northern tier of States to any steep-sided gulch or water-channel, and at times even to a stream-valley of considerable length. The term was doubtless derived from the French verb *couler*, meaning to flow. This use of coulee should not be confused with the geologic use of the word, which signifies a solidified stream or sheet of lava.

Mosquitoes are generally thought to breed in water, but a recent report from Panama states that full-grown mosquito larvae were found in mud devoid of free water. They were the culex of an undetermined species. At the same time full-grown culex larvae were found alive and active in a surface pool of water over which there was an apparently unbroken film of crude oil, but the film was an old one.

Under a mining contract requiring a man to employ four men per day for 20 working days per month, and giving him the right to all the ore taken from a main adit without stoping, or to 40% of the ore taken from side drifts and stopes, he did not comply with its terms when he worked a less number of men for a greater number of hours, nor was he entitled to keep ore taken from an old adit or stope which had already been opened.

The ore deposits on Douglas island, Alaska, consist of mineralized dikes of albite-diorite intrusive in black slates, and belonging to a series of intrusive bodies that appear at intervals along a zone approximately 3000 ft. wide and three miles long. The mineralized dikes are cut by reticulating veinlets of quartz and calcite. Both dikes and veinlets may carry metallic sulphides and gold. Although a high gold-content may be found in picked specimens, the commercial value of the deposits lies in the wide dissemination of mineralization that renders great bodies of dike-material available as ore. The output to date is $58,318,780.

Explosives are briefly described in the following: Nitro-glycerine is made by treating glycerine with a mixture of nitric and sulphuric acids. It is a colorless, odorless, oily liquid. Nitro-cellulose is made by heating substances containing cellulose, like cotton, wood pulp, etc., with a mixture of nitric and sulphuric acids. Black powder is made by mixing 75% saltpetre, 10% sulphur, and 15% charcoal. Nitro-cellulose gunpowder is made by mixing nitro-cellulose with ether and alcohol. Dynamite is made by the absorption of nitro-glycerine in infusorial earth, wood pulp, etc. Picric acid is very powerful, and is made by mixing carbolic acid with nitric and sulphuric acids. Trinitroltoluene is made by mixing toluene, extracted from coal-tar, with nitric and sulphuric acids. Fulminate of mercury is made by treating quicksilver with nitric acid and alcohol.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

BOSTON

Copper and Zinc Shares.—Ely, Nevada.—Boston Interests in California.—T. W. Lawson's Activities.

The copper share-market is getting symptomatic of forthcoming activity, possibly a big bull movement. The symptoms are the result of news from various copper districts. When market conditions are auspicious it is wonderful how much news comes in.

It has been a neck and neck race in the market between American Zinc and Butte & Superior, the 'zinc-dust twins,' but the former recently passed the latter in the quotations of stock. Some of the reasons given are that American Zinc has its own smelter, is not bothered with litigation, and produces high-grade spelter, in much demand by the cartridge-makers.

A Boston Stock Exchange house, in connection with New York interests, will shortly bring a new porphyry on the market. The name and situation are not given, except that the property is in Arizona. Its area is over 200 acres, and grade of ore is about 2.60% copper. Henry Krumb, is consulting engineer. The property is being drilled and a considerable quantity of ore occurs. [This is probably the Ray Hercules Copper Co., organized last week to absorb the Arizona Hercules Copper Co., working in the Ray district, Arizona, on what is said to be a continuation of the Ray Consolidated orebody. Directors are as follows: August Heckscher, director of the New Jersey Zinc Co.; Ellis P. Earle, vice-president of the Granby Consolidated company; J. Guthrie Hopkins, director of the Arizona Copper Co.; G. A. Huhn, banker, Philadelphia; W. F. Bartholomew, broker, Boston; Frank C. Armstrong, New York, president.—Editor.]

An examination for parties interested in the Coppermines company at Ely has been made by J. Parke Channing, and he is said to have recommended development, especially in that part of the property adjoining the Nevada Consolidated. It is understood that people close to Nevada Consolidated have acquired some of this stock, and it has been suggested that Nevada Consolidated control would like to take it over. The Coppermines area is over double that of its neighbor. The company is now receiving a good monthly revenue from the Nevada Consolidated through the latter's operations on the Ora claim of Coppermines.

Boston traders wonder why they are not given the opportunity to trade more in California mining and oil stocks. Such stocks, properly presented, would attract support. Early in June the Ventura Consolidated Oilfields was listed on the Curb, and removed a month later to the Exchange, on both markets making a strong and active record. Copper concerns, like First National, Trinity, and Calaveras, have done well here at times in a market way, but Boston has been led to hold an adverse opinion of California as a copper-producing state. The anti-smelter activities of the Shasta farmers has created a good deal of prejudice against the copper mines of California in the minds of Boston people. Not long ago the stock of the Globe Consolidated Mining Co., of Dedrick, Trinity county, was listed on the Curb, but the interests in charge of the market here were not such as to inspire confidence, as it appeared, and the stock 'died.' There is talk about shares in the Excelsior Consolidated Mines, Meadow Lake district, Nevada county, being brought out on the Curb. This property is controlled at Worcester, Massachusetts, and considerable money has been spent in preparing it for production. A revival of interest in the Meadow Lake district has been reported here. Should Trinity and First National combine, and the trouble with the farmers be adjusted in the Shasta area, a favorable opportunity will arise for renewed interest throughout New England in California mining enterprises. The Ames family, of transcontinental railroad fame, almost a generation ago spent a great deal of money equipping the Calaveras mines and estate.

The long absence of Thomas W. Lawson from the Street was broken a few days ago by his appearance in brokerage circles, looking himself again. It is said that he has formed a coalition with ex-Governor Foss to campaign the stock-market. He has addressed a circular to holders of First National Copper Co.'s stock, asking them for, in consideration of $1 and other valuable things, an option on their holdings of stock. Lawson has been actively conferring with New York, and it is believed a consolidation of Trinity and First National is to be proposed. Some time ago it was stated that the Bully Hill, Sugar Loaf, and one or two other properties were to go into this merger, with Lawson as President. Trinity has a property of 1700 acres, including a townsite; First National has about 1150 acres about three miles from Coram, and the Balaklala smelter at Coram; and Bully Hill has an estate of about 213 acres, situated about 25 miles north-east of the Balaklala smelter, equipment including a 250-ton smelter, which was closed down in the summer of 1910, the Forest Service claiming that the plant was damaging the trees. It is said that Lawson believes a big copper movement is coming, following the war babies. Another statement about Lawson credits him with joining forces with N. L. Amster, the well-known copper man, on Rock Island, the minority interests of which Mr. Amster has been championing for the past two years.

DEADWOOD, SOUTH DAKOTA

Rates for Ore Treatment.—Wasp No. 2 Dividends.—Blasting Accident.—North Homestake, Echo, Hidden Treasure.—Tungsten.

New rates for ore treatment have been made by the Mogul Mining Co., they are as follows: On ore worth up to $6 per ton, the charge is $1.50 per ton; on $6 to $8 material, $1.75, and on ore above $8, $2 per ton. The shipper is paid for 75% of the assay-value in gold. With the new oil engine in operation the capacity of the plant has been increased nearly 50%; it is now handling 150 tons daily. It probably will be possible to handle a greater quantity after some other improvements are made; one of the most important of these, so far as tonnage is concerned, will be completed when a second elevator is installed, work on which is now under way.

A dividend of 10c. per share, paid on October 11, marks the largest single distribution made by the Wasp No. 2 company. Former dividends this year have been at the rate of ½c. and 1c. each; the present is the fifth declaration of the year. The company has been shipping some wolframite ore, for which fancy prices have been received; but in the meanwhile the 500-ton mill has been making profits right along. The wolframite was extracted during the mining of gold ore.

Nearly a miracle occurred recently in the Oro Hondo shaft, when a miner was uninjured, although he was in the bottom

while a round of 15 holes exploded. It seems that he and two other men had given the hoisting engineer on the 1500-ft. level the blasting signal; had received the answer from the engineer, had spit the fuses, and given the hoisting signal. The engineer opened the throttle, pulled the bucket up about 4 ft., when the engine, which is driven by compressed air, stuck on a dead centre, probably because of the slow speed at which it was operating. In order to get it over the centre the engineer allowed the bucket to drop back, slowly, a short distance. Here one of the men got excited and jumped from the bucket, his light went out and he did not see the bucket disappear over his head. His companions missed him and grabbed the bell cord, gave the signal to stop, and about this time the man who had been left, started to climb the bell cord, thus giving the engineer another hoisting signal, which carried the bucket and two men to safety on the 1500-ft. level. Of course the bell cord parted before the man in the bottom had reached the timbers, and he found himself right in the middle of 15 holes loaded heavily and about to explode. Getting in a corner he barricaded himself with planks and heard eight of the holes go off; he says he heard no more until his companions returned to get his remains on top for the undertaker. He suffered a few bruises of a slight nature and a mental and nervous shock that incapacitated him for a few shifts, but was otherwise unharmed by his thrilling, and, to use an old expression which applies in this case, hairbreadth escape.

Work is progressing favorably at the North Homestake property, at Maitland, where a drift is being driven south, following a quartz vein in the schist. Assays are encouraging. This work, at a depth of 600 ft., nearly 400 ft. below the quartzite should disclose some interesting ore formations.

The Echo shaft, at Maitland, has reached a depth of 180 ft., and fair progress is being reported, notwithstanding extremely hard rock and all of the water that a No. 5 Cameron sinking pump will handle. A station is to be cut at 200 ft., and, lateral work done on that level.

Numerous 'ore-verticals' have been met with in the crosscuts at the 200-ft. level in the Hidden Treasure shaft, in Deadwood gulch. The east cross-cut has been advanced 60 ft., and 70 ft. of work has been done west.

Hill City is experiencing a small tungsten boom; but which gives promise of developing into something bigger, as energetic prospecting is exposing a considerable quantity of ore. Within a few weeks two mills will be busy concentrating the lower grades. Hand-sorted ores are shipped direct to the consumers. The American Tungsten Co.'s property shows one of the strongest veins. It is quartz, from two to eight feet wide, containing high-grade wolframite. On the Black Hills Tungsten Co.'s property are two well-defined veins of good ore. Both of these properties are equipped with mills. A small army of prospectors is working, and numerous locations are being recorded.

CRIPPLE CREEK, COLORADO

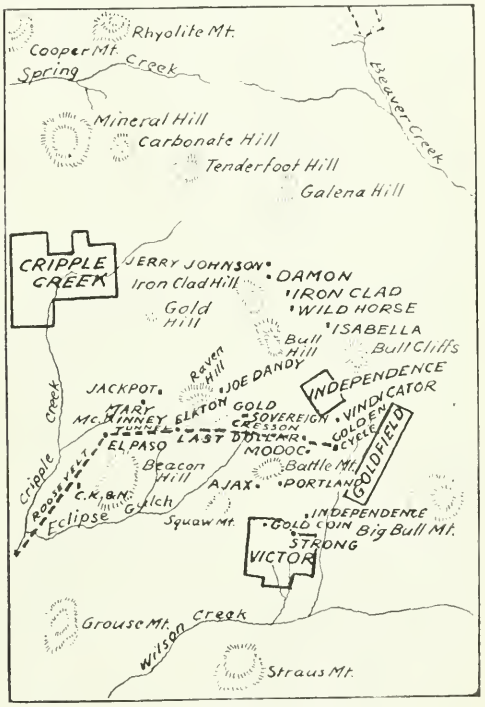
PORTLAND AND GOLD SOVEREIGN.—DRAINAGE TUNNEL.

The past week has been an important one for the district. Rich discoveries are being made nearly every day. While some of the reports are exaggerated by newspapers, yet when the truth is known they are often worth more than passing notice.

During the week important developments have been announced from the Portland, Gold Sovereign, C. O. D., and El Paso properties. Of these, the one officially reported by the Portland company is of greatest moment, both for its influence on future work on the deeper levels, and for its value to the district. On the 1800-ft. level the company has opened No. 1 vein, and as far as driven on it is as wide and assays as well as on No. 17 level, about 150 ft. above the new, or lowest, level. The persistency of good ore to such depths in the Portland will doubtless have a great influence on deep-level exploration on other properties being developed in the Cripple Creek district.

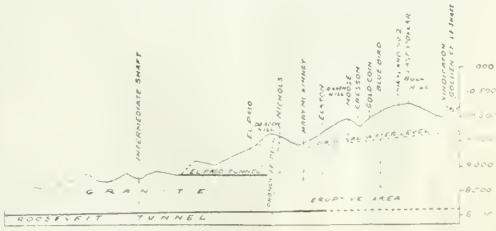
In the Gold Sovereign it is claimed that a continuation of the rich Cresson ore-shoot has been discovered. The Gold Sovereign adjoins the Maggie claim in which the Cresson company found the very rich ore last December. Ore in the new development is said to be similar to that in the Cresson, and contains high gold-content.

At a recent important meeting of the executive committee of the Cripple Creek Deep Drainage & Tunnel Co. at Colorado Springs, it was decided that the Tunnel should be driven in a straight line from the Elkton shaft to the main shaft of the



MAP OF CRIPPLE CREEK DISTRICT.

Golden Cycle. The distance between the two shafts is 8000 ft. T. R. Countryman was formally appointed chief engineer for the committee. The superintendent, Mr. Fuller, who



SECTION OF CRIPPLE CREEK, SHOWING DIRECTION OF DRAINAGE-TUNNEL.

is in charge of operations, reported a daily advance of more than 10 ft. per day. The Tunnel project was described by T. H. Sheldon in the *Engineering and Mining Journal* of October 2. Drainage of the district is all important for the future.

MONTERREY, MEXICO

Optimistic Feeling Resulting From Recognition of Carranza.

An immediate revival of business in the territory that is under the control of Carranza is probable, according to reports that have been received here from many centres. Large numbers of refugees are returning from the United States, and are resuming business. Orders for great quantities of machinery and general supplies have already been placed in the United States, and considerable trade in these lines will continue for some time replacing the depleted stocks of the merchants, and rehabilitate the industries of the country.

Much interest has been aroused by the announcement that 25 wholesale merchants and manufacturers of St. Louis, Missouri, have organized a trade excursion to visit Mexico in the early part of December. They will travel by special train, and will go as far south as Mexico City, stopping at Monterrey, Saltillo, San Luis Potosi, and other places.

Traveling representatives of San Antonio and El Paso concerns are already placing large orders in the territory where tranquility now reigns. In former times Mexico was a large buyer of goods and machinery in Germany, France and England. This source is now closed, and the United States will be called on for the supply. No anti-American sentiment exists among the native business and industrial element of Mexico. This feeling of antagonism towards the people of the United States is confined to a group of political agitators, and a small portion of the military class. The men who are really in charge of the reconstruction of the country realize fully that it is only by American trade and American capital that prosperity can be fully restored and maintained here.

During the long period of revolution, stocks in the stores became exhausted; machinery at the mines and mills grew rusty and obsolete; farm implements went to ruin; tracks and equipment of the railroads were destroyed or neglected; and it is now necessary that all these things be replaced in order that business may be able to resume its normal pace.

It is expected that mining and oil development especially will respond quickly to the influences of the promised era of peace. The copper resources of the country are known to be extensive, and in view of the high prices for base metals it is expected that much attention will be given to the development of such properties. The vast oilfields of the gulf coast region around Tampico are capable of larger output. There is a great deal of American and British capital already invested in oil lands, wells, pipe-lines, and refineries in that territory, and it is expected that with the establishment of a stable government in Mexico there will be great investment of capital from across the Rio Grande.

During the last few days many American farmers who abandoned their homes in different parts of Mexico during the period of turmoil have passed through here on their way back to their properties. Some of the settlers will have to begin all over again, but they seem to be optimistic as to the future.

KETCHIKAN, ALASKA

Ore Transport.—Smelter Charges.—Custom Plant.—Copper-Gold, and Gold Ore Producers.—Promising Prospects.

Transportation facilities are causing some delay in shipping ore from the small mines of this district. This is partly on account of the large amount of freight going out at this season of the year, such as fish from the canneries; and partly owing to the mines being located at some distance from the main steamer route. Large producers, which can guarantee a regular quantity at certain intervals, are usually not subject to these conditions, and can also procure lower freight and smelter rates on their ore.

Another difficulty of operating small mines here is caused by variable charges made by smelters. Recent instances are known whereby smelters have offered fairly reasonable rates to small properties, and then raising them much higher after the miners have gone to the expense of getting the ore ready for shipment. Smelter charges are somewhat confusing; one company deducts from 1 to 1.3% of the copper, as slag loss from the ore; another, while only deducting from 0.4 to 0.5% copper as slag loss, makes an excessive charge for smelting the ore.

It has often been suggested, and a petition has been sent to Washington, asking the Government to establish a reduction plant under the supervision of the Bureau of Mines, to consist of a concentrating mill and smelter, for treating custom ore in this district. A large number of small operators could send ore cheaply by utilizing small scows towed by gasoline boats, as nearly all the mines are on inside and protected waters. A competent staff, and appliances for conducting experimental research on the different ores would give the miners operating on small, as well as large properties, an opportunity to have their ore tested for suitable metallurgical processes at a reasonable cost. A situation for such a plant could easily be selected on one of the numerous harbors where sufficient water-power is available, and would be of great benefit in developing this district. There seems no reason why a plant of this kind should not be a commercial, as well as a developmental success.

The mines producing copper-gold ore at the rate of 500 to 1000 tons per month at present are the Jumbo at Sulzer, and Rush and Brown at Karta bay.——The It and Mamy mines are producing about 4000 tons per month.——The Cymru at North arm has a small amount of high-grade copper ore in bunkers waiting for transportation.——The Goodroe mine is being operated on a small scale and has some ore ready for shipment.

Among the gold mines, the Princton Mining Co. at Dolomi, is operating a 40-ton mill, and the management expects to continue operations throughout the winter; a shortage of water has hindered work at this mine during the unusual dry summer.——Dunton & Capp, under a lease from the owners, are shipping some high-grade gold ore from the Helm Bay property.——The Granite Mountain mine is being developed on a small scale by T. Stevens. An arrastra has been built for treating some of the high-grade free-milling ore opened. The vein carries mostly concentrating ore.——The Goldstream mine, at Ketchikan, has been sold to the It Mining Co., and is being pumped out.

A number of large copper-gold deposits are laying idle at present, the ore of which is too low grade for shipping to smelters, but is amenable to concentration by flotation, etc. No such treatment has yet been attempted here.

TORONTO, ONTARIO

Results at Kowkash.—Hollinger Production.

Interest in the Kowkash goldfield is well maintained by reports of further discoveries, that show the extent of the gold-producing area. Ore has been found near Redmond station, 12 miles west of Kowkash; about 8 miles north-east from the original discovery at Howard falls; and near the shore of O'Sullivan's lake, five miles farther north-east. All of these places are in the Keewatin belt, regarded by Percy Hopkins of the Geological Survey as being worth prospecting. Free gold is also stated to have been found along Gold creek, six miles south-west of the original discovery. The area immediately around the King Dodds claims is being actively developed, and a number of promising quartz veins and stringers have been disclosed.——On the Pullis claim, a long vein, 30-in. wide, of heavily mineralized quartz has been uncovered, and to the south across the river a dike of quartz and schist has yielded good assays. About 100 men were at last accounts engaged in development in the new district.

The Hollinger, at Porcupine, during the period ended September 9, made a gross profit of $149,935 from the treatment of 28,172 tons of ore. The average value was $9.03 and working costs $3.17 per ton milled. The total surplus is $1,331,461.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

In Bulletin 622 of the U. S. Geological Survey, by Alfred H. Brooks and others, the mineral resources of Alaska, and report on progress of investigations in 1914 are described. With maps and illustrations the publication covers 380 pages. Much of the information has been given in the PRESS as the preliminary reports were issued. On an appropriation of $100,000 for 1914, geologic surveys of all kinds covered 9025 square miles, and topographic 10,910 square miles.

The promise of adequate transportation facilities to the Willow Creek mining district by the building of a Government railroad to the interior, has increased the interest of Eastern capital, and resulted in greater activity by local operators. One of the latest developments is the incorporation of the Talkeetna Mining Co., headed by J. L. Fulton, of Portland, Indiana, which has taken over the claims of the Alaska Quartz Co. and the Matanuska Gold Mines Co. and will proceed to operate on an extensive scale. Associated with Mr. Fulton are Robert L. Hatcher and Eugene H. Bartholf, old-timers in the territory, and Judge P. C. Ellsworth of Seattle.

ARIZONA

Cochise County

The pay-roll of Douglas, including the two smelters, railroads, and other industries, is approximately $450,000 per month, and the place is prosperous and optimistic. Less concentrate is coming from Nacozari, owing to the revolution near-by.

At the Junction shaft of the Calumet & Arizona property, at Bisbee, motor haulage was started last week on the 1600-ft. level.

Concreting the Copper Queen Sacramento shaft was commenced early this week.

The Higgins Leasing Co. is doing a great deal of development, and continues shipments of ore. Twenty additional men have been put on.

Gila County

The Inspiration mill is treating 5000 tons per day. The mine is producing over 6000 tons, so the surplus goes to the Webster gulch storage-bins. Larger cylinders are being fitted to the Ingersoll-Rand compressor, also Rogler valves.

Greenlee County

Events in the Clifton-Morenci strike zone during the week were as follows:

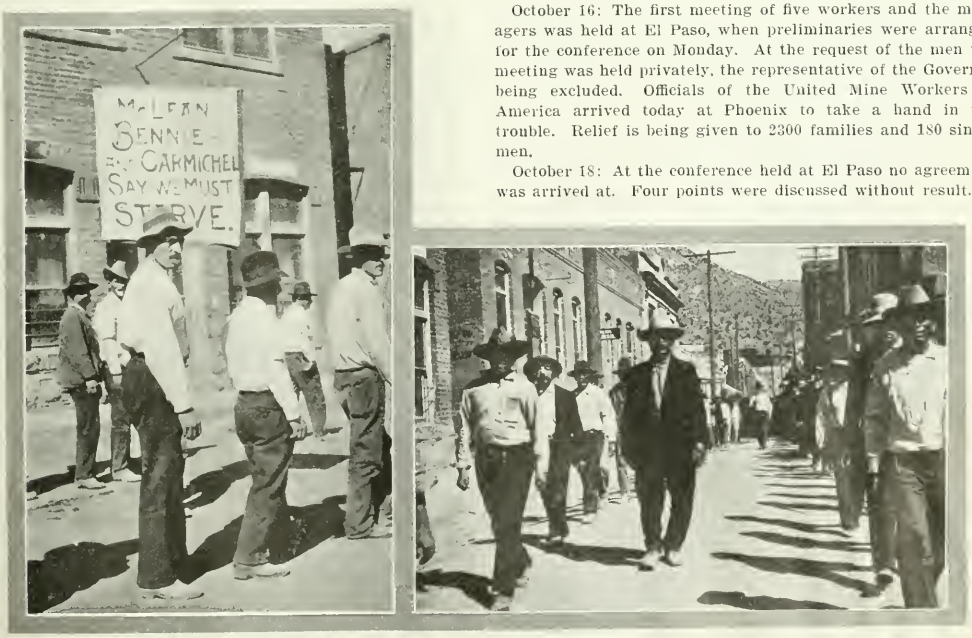
October 11: A committee of seven went from Clifton to El Paso to interview the managers of the copper companies shut down by the strike. The managers refused to meet more than five delegates, these to include no Western Federation men, but two representing the Mexican employees, and only the original grievances were to be discussed. The Governor of Arizona was very surprised at this action.

October 13: The strikers at Clifton choose 15 men, from whom the managers will select five for a discussion of the situation.

October 15: It is reported that there are signs of dissension among the strike leaders. The management of the relief fund is the subject of discussion.

October 16: The first meeting of five workers and the managers was held at El Paso, when preliminaries were arranged for the conference on Monday. At the request of the men the meeting was held privately, the representative of the Governor being excluded. Officials of the United Mine Workers of America arrived today at Phoenix to take a hand in the trouble. Relief is being given to 2300 families and 180 single men.

October 18: At the conference held at El Paso no agreement was arrived at. Four points were discussed without result.



STRIKERS' PARADE AT CLIFTON. NOTE THE MISLEADING STATEMENT ON THE BANNER, ALSO THE MEXICANS.

Mohave County

A special edition of the *Mohave County Miner* covers the mining industry of this county. The area is 13,500 sq. miles, of which 7000 are mineralized; the altitude is from 2000 to 7000 ft.; the population is 5000. The descriptive matter dealing with the mines of the region is suitably accompanied by good plans and photographs.

The monthly output of the county is approximately as follows: Golconda, $250,000; Tennessee, $150,000; Tom Reed, $100,000; Copper Giant, $100,000; Gold Road, $70,000; Champion, $35,000; and sundry $35,000; a total of $740,000. Tungsten ore is worth $35 per unit in this county, this being the price paid by the Primos Chemical Co., which buys the local ores. Molybdenite is $3500 per ton for 90% ore, and the mines at Copper Canyon will soon be benefiting from this high price. The American Molybdenum Co. is erecting a mill there.

Booming of the county continues.

CALIFORNIA

Amador County

The following is the preliminary report of the output and costs of the Plymouth Consolidated in September:

Ore milled, tons	10,800
Total value	$53,076
Working expenditure	$30,302
Development charges	$ 411
Surplus	$22,363
Other capital expended	$ 250

It is reported that the Kennedy company, which bought the Zeila mine at Jackson, is sinking a new shaft and experimenting with flotation to treat the low-grade ores.

The Original Amador is sinking its shaft, and will curtail work in the meantime.

The north shaft of the East Eureka mine near Sutter Creek is being prepared for resumption of operations. It has not been used for 20 years.

Butte County

According to Oroville papers the Forbestown district is having a big revival. Men are flocking into the place. A number of properties have changed hands, and other deals are under way. At the Forbestown Consolidated there are 25 men at work. The 20-stamp mill is being overhauled.

On October 19 the Viloro Syndicate's (London) dredge at Oroville was destroyed by fire, the result of a short-circuit. The boat had been digging over various areas and had enough ground for two years' work. The gold recovered had returned the original capital of £70,000. The last dividend year totaled 18¾%. The boat, insured for $50,000, was originally the California No. 3 of the Oroville Dredging Company.

Calaveras County

High-grade tungsten ore has been opened in the Rustle mine near San Andreas. The vein is 12 in. wide, and has been opened for 20 ft., giving indications of an extensive deposit.

Eldorado County

Six miles from Placerville the Webber Creek Mining Co. is preparing to mine its gravel with a steam-shovel, locomotive, side-dump cars, and sluice-boxes at the rate of 100 yd. per hour.

Kern County

(Special Correspondence.)—Legal action has been taken by Mrs. DePauw, widow of the late John Singleton, one of the owners of the Yellow Aster property, against attorney Ward Chapman, who is acting as executor of the Singleton estate. She contends that the attorney is evading the order of Judge Works of Los Angeles, commanding him as executor of the estate to pay $100 a month for the support of Singleton's 10-year old daughter. Coming on the heels of a recent action by Mrs. DePauw to gain control of the directorship of the Yellow Aster Mining Co. before Judge M. J. Rogers of Ventura, the case is creating unusual interest. In settlement of the estate recently a court decision was obtained granting Singleton's daughter one-fourth of the estate, and an allowance of $100 per month. John Singleton was one of the three partners who located the Yellow Aster group of claims here in 1895, comprising Burcham, Moers, and Singleton. Mrs. Rose Burcham, present secretary of the Yellow Aster company, widow of one of the original locators, has always been identified with the promotion and development of that property which has been for years the largest producing mine in Southern California. At present about 200 miners are employed in the mine and mill of 150 stamps. About 300 tons of ore is extracted and milled daily. During the eight months ended August 31, the gross earnings were $305,584, of which $106,516 was profit. Dividends absorbed $11,000, and most of the balance was spent on development and improvements.

Patrick H. Murphy, of Randsburg, aged 48 years, a well known miner, was killed by an explosion of a missed blast, near Silver lake, Mono county.

The old Goler placers are about to be re-worked through the efforts of former Senator Nathan Hale, of Tennessee, who has succeeded, after two years of disappointing labors, in developing water enough for placer mining purposes in the wash adjoining Goler, and just west of the Yellow Aster pumping-plant. Three wells are nearly completed, and water will be lifted by electric power from the Southern Sierra Power Co.'s line to a reservoir elevated about 300 ft. above Benson and Nugget gulches. It is proposed to re-use the water in working the old placer properties bonded and optioned by the Velmedith Mines Company.

J. F. Fienan, C. C. Passer, and other Randsburg miners, have just succeeded in recovering the old antimony mine near Havilah, by ejectment proceedings before Judge Farmer of Kern county. The increase in prices for antimony is responsible for re-opening of this property.

John M. Hepp, publisher of the *Randsburg Miner*, has a promising lease at the Sunshine mine.

Randsburg, October 10.

Nevada County

The Polar Star Mines Co., Oscar Coffin superintendent, is to develop its property thoroughly, and the Taylor Foundry & Engineering Co. of Grass Valley is to erect new machinery. This will consist of a large motor-driven hoist, motor-driven triplex pump, duplex Laidlaw-Dunn-Gordon air-compressor, and various General Electric motors.

After being unwatered, and some work done on the 400-ft. level of the Kenosha mine, the owner, G. F. Drake, has opened specimen ore, over 150 lb. of which is on view at Grass Valley.

The new 20-stamp mill at the Brunswick Consolidated started work on October 16. It consists of a 10 by 16-in. jaw-crusher, suspended feeders, twenty 1250-lb. stamps, copper plates, four Wilfley tables, and six Frue vanners. Motors drive everything.

Plumas County

In the Soda Creek district the Plumas Amalgamated Mines Co. owns 17 gold quartz claims. The Monitor group has been worked on and off for about 40 years. Keddie, on the Western Pacific railroad, is 15 miles east of the property. Haulage to the mine costs $10 per ton. Besides the usual equipment at the mine there is a 10-stamp Straub mill. A good tonnage of fair-grade ore has been opened in the claims, and possibilities are considered to be encouraging.

San Bernardino County

(Special Correspondence.)—A piece of scheelite float, over 200 lb. in weight, was found this week by Anderson and Roberts on their lease near here. High-grade scheelite, over 60% WO_3, is selling at $30 to $32 per unit, and is creating unusual activity among the 'float diggers.' Since finding the big lump, valued at over $200, the vein has been found, it being from 2 to 4 ft. wide, averaging about 20% WO_3.

Lessees at the Osdick properties near here have purchased

a 12-hp. engine and crusher, preparatory to installing jiggers and concentrators. An 8-ft. vein of scheelite of good quality has been opened about 30 ft. from the top of bed-rock nearly half a mile from the Atolia mill. Miners are jubilant, as this discovery insures a good future for the camp, which is now already a big tent city.

The Atolia Mining Co. is laying a pipe-line over the mountain to Randsburg, ostensibly to pump the surplus water from the Consolidated mines to this place. Heretofore all water used at Atolia has been hauled there by tank-cars over the Santa Fe. The new supply is said to be adequate for all purposes here, where there is a population of over 200 people.

Irving Hopper, who has tungsten interests near the Atolia company's ground, has gone for a Keystone drill with which to prospect the Osdick and Scheelite groups, comprising 16 claims.

Atolia, October 10.

Tuolumne County

The well-known Rawhide mine near Sonora has been sold to the Silver Peak Mining Co. of Nevada. John Mocene is superintendent. The shaft, 1800 ft. deep, is to be unwatered and re-timbered.

COLORADO

Boulder County

Tungsten ore producers of this country are receiving between $200,000 and $300,000 per month for their outputs. Sixty per cent ore is worth $1800 per ton. Miners in the Nederland area are making large profits. The Primos Chemical Co. is buying most of the ore, but the Crucible Steel Co. has entered the field.

Dolores County

The Rico district produced 62 cars of ore during September. Of this, 55 cars were from the Rico Wellington property, where 43 men are employed. Development in this, and the Rico Consolidated and Rico Carbonate is satisfactory.

Lake County (Leadville)

Approximately 120,000,000 gal. of water was pumped from the Down Town mines in August, according to Jesse F. McDonald. Since May 8 the Penrose pumps have discharged about five times this quantity. The pumps are now at 650 ft., where the shaft is not in very good condition.

Good progress is reported from the Anderson adit, and the surface of the property is busy during construction of plant.

The new dredge on the Derry land has been at work for two weeks, and attracts considerable attention.

Ouray County

Judging by the snow fallen in the mountains, winter has set in. About 5000 tons of 5% copper ore has been opened in some old workings of the Wanakah mine. The smelter is at work again.——Development at the Gold Crown Mining & Reduction Co.'s property is giving good results. The 300-ton mill will be finished early in January.

IDAHO

Custer County

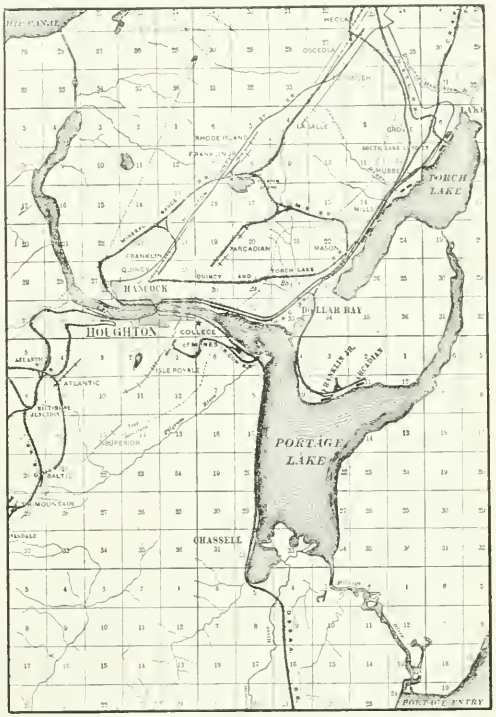
The Lost Packer Mining Co. held its annual meeting at Salt Lake City last week; James Ivers is president, and Henry Welsh secretary. The property is in good condition, and the new 50-ton mill will soon be finished, but will not start until next March. It will treat the lower-grade silicious ore, about $20 per ton, of which there is over 20,000 tons in the mine, according to the superintendent, John P. Boyle. The local smelter will reduce the concentrate and high-grade ore to matte. The smelter is of 100-ton capacity. Owing to its situation the mine is worked under serious difficulties.

MICHIGAN

The Copper Country

A heavy earth tremor or air-blast was felt over a considerable area of this region last week, no damage was reported from any of the mines.

Shipping through the Portage Lake waterway during September was as follows, east bound, 6019 tons copper, 5040 tons iron ore, 3200 tons mill sand, and total of all materials,



THE PORTAGE LAKE WATERWAY, MICHIGAN.

97,289 tons; west bound, 140,297 tons soft coal, 25,308 tons hard coal, 705 tons copper, 1936 tons nitrate of soda, 3348 tons limestone, 39,000 bbl. cement, 45,017 bbl. salt, and a total of all materials 215,906 tons. The quantities were less than in August.

MISSOURI

Jasper County

A large number of small companies are prospecting on the Missouri Lead & Zinc Co.'s area in the south-east part of Joplin. As one section has been drained, many sub-leases have been let. The company is drilling, and will lease the ground where ore is found.

Treatment of old dumps at the south end of Joplin is giving fair profits.

MONTANA

Beaverhead County

A 150-ton cyanide-plant is to be erected at the Bannack Gold Mining Co.'s mine at Bannack next spring. Over 150,000 tons of ore has been opened in the mine. Development is done by adits. George T. Hansen, Salt Lake City, is managing director.

Fergus County

(Special Correspondence.)—In spite of the litigation between the Kendall and Barnes-King companies that has prevented mining in the disputed ground in the North Moccasin mountains, development has been active in Fergus county this

summer. The outlook is excellent for the addition of a number of mines to the present producers in the Judith and North Moccasin mountains.

The Kendall company now employs 20 men on development, mostly below the 500-ft. level, and the mine will probably soon be an important gold producer again. The upper 300 ft. of the mine has been leased with half of the mill. The lessees are making a success of their venture, taking their ore chiefly from the open-cut.

The capitalization of the West Kendall company was increased from $1,000,000 to $2,000,000 at a meeting held at Lewistown, on October 2. Development has disclosed a large amount of gold ore, mostly low grade. In the spring the company proposes to erect a mill. A large building has just been finished to provide better winter accommodations.

Another property in the North Moccasin mountains on which development has been done is the Blue Belle, located by Foster and Helsing. A trial shipment of 17 tons of lead, silver, and copper ore yielded $30 per ton after paying a heavy penalty for its zinc content.

Six hundred feet of the adit on the Gold Acres property at New Year is now completed, and the president, A. S. Wright, expects that the orebody will be cut a few hundred feet farther in.

Hawkins and Sutter have been busy opening a copper claim in the Cone Butte district near Maiden in the Judith mountains. Some good ore has been found.

Peter Rosso, owner of the Silver Bullion mine near Maiden, is to erect a 15-stamp mill to treat the gold and silver ore he discovered recently. Some rich ore has been opened, the shaft being down 80 ft. If the gold-content persists in depth this will be important, as the vein is five feet wide; it has been traced for a length of 2000 feet.

Lewistown, October 5.

During September the Barnes-King Development Co.'s North Moccasin mine yielded $16,000 from 2900 tons of ore, and the Piegan-Gloster between $10,000 and $12,000. The dispute with the Kendall company is still pending.

Silverbow County

Representatives of the I. W. W., W. F. of M., and other labor combinations are reported to have tried to start trouble at Butte last week, but failed entirely. The situation is as desirable as could be at present.

The Davis-Daly mine is developing well, especially at 2500 ft. depth, where the Hesperus vein has been opened for 150 ft. It is 12 ft. wide, 5 ft. being first-class. The daily output is 100 tons of 6% ore.

The Elm Orlu-Butte and Superior suit commenced on October 18; great interest is being taken in the dispute. A large electric hoist, similar to that at the Granite Mountain shaft of the North Butte, constructed by the Nordberg and General Electric companies, has been ordered for the Elm Orlu. This and other improvements are to cost $125,000. The main shaft is to be sunk to 2500 ft. from 1700 ft. The Timber Butte mill, which treats the Elm Orlu ore, is treating by flotation 500 tons of 17 to 20% ore, extracting 94 per cent.

After a 40 days' shut-down, during which the plant has been overhauled and enlarged, the Butte-Alex Scott company resumed last week. The hoist has now a capacity of 3-ton skips from 3000-ft. depth. Ore is being extracted from 1900 and 2000 ft. In a few days the output will be 200 tons per day, and within 90 days 300 tons. The ore assays 5% copper.

A new hoist, Ingersoll-Rand air-compressor, and building, etc., have been erected at the Butte & Great Falls mine, six miles north-east of Butte. Everything is electrically driven. The mine is now to be unwatered, and development commenced. The officials are pleased with prospects.

The Jessie vein at 2800 ft. in the North Butte is 7 ft. wide, assaying 7% copper, with masses of 20% glance. The Granite Mountain shaft is to be sunk from 3000 to 3400 feet.

In the Anaconda-Pilot Butte suit the State supreme court has modified the order of the district court; the defendant can now increase its production. The 800-ton flotation-plant at the East Butte will soon be finished. Second-class ore and tailing will be treated.

The September output of the Butte and Superior was as follows: ore treated, 40,360 tons; concentrate saved, 11,579 tons; assay of concentrate, 55.92% zinc; recovery, 92.79%; and spelter in concentrate, 12,950,000 pounds.

During the lowering of powder down the North Butte's Granite Mountain shaft 15 men were killed by an explosion at the surface on October 19. The company is negotiating for the purchase of the Butte-Duluth property.

NEVADA

Humboldt County

A 50-ton tungsten concentrating-plant is being erected by the St. Anthony Mines Co. near Toy on the Southern Pacific line, 21 miles south-west of Lovelock. A good deal of ore is said to be ready in the mine for treatment.

The Friedman adit was in 1150 ft. on October 17, in hard rock. The Rochester Mines Co. has 2400 tons of mill ore broken in stopes.

Mineral County

The Louisiana Consolidated Mining Co. has acquired for $30,000 the Tip Top mine, 40 miles south of Mina. The property was sold in April to the Washoe County bank, to satisfy a judgment obtained by Walter E. Trent for plant supplied. He will remain as manager. The 10-stamp mill and cyanide-plant produced $80,000 in eight months. The plant will be enlarged.

Nye County

Tonopah mines last week produced 9761 tons of ore worth $201,658. Some September returns were as follows: Belmont, 12,008 tons for 226,844 oz. bullion, and a profit of $65,018; Jim Butler, profit of $22,232; and Tonopah Mining, 12,057 tons for 206,400 oz., and $51,720 profit.

Storey County

Five feet of ore on the hanging wall assaying $200, and 5 ft. on the foot-wall worth $20 per ton, was opened at 2500 ft. last week in the Union Consolidated, on the Comstock. The ore is being sent to the Mexican mill.

White Pine County

(Special Correspondence.)—A two-foot vein of scheelite, that can be traced through five claims, on the east side of the range, opposite the U. S. Tungsten Co.'s mine and mill, south of Osceola, has been opened by Marriott Bros. It is said to be high grade.

Lowe and associates recently shipped a carload of 70% lead ore from their property up Berry creek, east of McGill. They have a good property.

The shaft being sunk on the Willow Creek Con., south-west of Ely, averages $200 per ton across two feet at a depth of about 50 feet.

Ely, October 10.

According to the Nevada Consolidated company's *Safety First* for September there were seven disabling accidents at Copper Flat, four at the Ruth mine, six at the mill, and five at the smelter, none of which were very serious.

TEXAS

El Paso County

(Special Correspondence.)—Improvements to the A. S. & R. smelter at El Paso are to cost $300,000. Three large converters, electric cranes to carry molten matte to the converters, and a 300-ft. stack are part of the new equipment. The large increase in ores received from Arizona, New Mexico, and Texas, is responsible for the extension of plant; while more ore is expected from Mexico as affairs quiet there.

Regular shipments of copper-silver ore are being sent by

M. F. Jarrell from the Texas and Pacific mine near Allamore to the El Paso smelter.——S. Hackett in the same district expects to maintain one car of ore, high in silver, each week. ——Some promising copper claims have been located in the Carrizozo hills, between Allamore and Hot Wells, by L. R. Goldbaum of El Paso.

Up to the time of closing the railroad from Sierra Mojada to Escalon early in September, Paul Ginther of El Paso shipped over 500 tons of zinc carbonate ore from the Esmeralda and Constancia mines in Coahuila, Mexico, to the El Paso smelter.

El Paso, October 10.

UTAH

Juab County

The Iron Blossom company pays 5c. per share on October 25, equal to $50,000. The copper shoot at 900 ft. continues to open satisfactorily.——Work in the Ontario is being done as deep as 1500 ft. The low price of silver is a handicap to profitable operation.

The Eagle & Blue Bell mine will ship about 2500 tons of ore in October. Developments down to 1700 ft. are good. A large electric hoist is being installed. Profits to August 31 totaled $96,825, but are now at the rate of $200,000 per year.

A tailing-dump containing 200,000 tons of $4.50 material at the Eureka Hill has been leased to the Knight-Dern interests.

Salt Lake County

Large companies are said to be increasing their holdings in the Bingham district.

The Cardiff company is shipping from 125 to 150 tons of ore per day, yielding $30 per ton net at the smelter. A dividend of 50c. per share is expected for Christmas. About 100 men are employed.

The Pittsburg Consolidated Mining & Milling Co. is driving a 1200-ft. tunnel to connect the Little Cottonwood and American Fork sides of the divide. Sixteen men are employed.

Summit County

During the past three months the Silver King Consolidated made a profit of $188,000.

Tooele County

A large adit is proposed to drain and develop the Sharp claims in this county. Thirty carloads of ore have been shipped during the past two years from one shoot.

WASHINGTON

Ferry County

Ore shipments are to commence from the Laurier mine at Laurier, 12 miles south of Grand Forks, B. C. This property was located in 1896, and has had a varied history. As the adit is on a steep mountain, a 2100-ft. tramway was constructed to the railroad. The newer workings show 6% copper, 6-oz. silver, and $1.50 gold ore.

Stevens County

(Special Correspondence.)—The Mayflower mine, Chewelah district, is reported to be showing nine feet of ore at a depth of 50 ft., assaying $50 in gold and silver. It has been bonded to J. W. Douglas, who is associated with Volney D. Williamson in its development.

The president of the United Copper Co., Conrad Wolfle, is reported to have said that the property has been bonded to an Eastern syndicate. The mill is treating about 250 tons of ore daily. About 75 men are employed.

The Electric Point mine, near Northport, with two men, is yielding four tons of galena per day. Boulders of galena weighing over a ton have recently been extracted from this property.

Chewelah, October 15.

CANADA

British Columbia

On October 15 the Standard Silver-Lead company of Silverton declared a dividend of 2½c. per share.——On November 1 the Granby Consolidated will pay $1.50 per share.

The new 100-ton mill at the Galena Farm mine, near the Standard, is ready to operate. Over 35,000 tons of ore has been opened in the mine, which is mainly zinc ore, although lead-silver ore occurs. Concentration will go to Bartlesville, Oklahoma.

Lessees at the H. and E. zinc mine in the Salmo district shipped 71 cars of ore from March 1 to September 3, and will make a profit of $55,000. Spokane people have now leased the property.

According to F. R. Wolfle, general manager of the Florence company, operating near Ainsworth, a hydro-electric plant, compressor, and 200-ton mill, together with development, are to be installed at a cost of $150,000. A 4000-ft. adit is part of the development. Lead-silver-zinc ore is mined. The Highland mill of 100-ton capacity, 1¾ miles from the mine, is to be used in the meantime.

Manitoba

Gold has been discovered by D. Mosher and J. Hammell, 10 miles from Athapapuskow lake, north of The Pas. An extensive vein of high-grade sulphide ore is said to have been discovered. The district around The Pas was described in the Press of June 19.

Ontario

During September the high and low-grade mills of the Nipissing treated 76 and 6691 tons of ore respectively, yielding a total of $178,484, $58,610 from the former and $119,874 from the latter. Shipments of bullion from all sources amounted to $120,976. The usual amount of development was done.

The Kerr Lake Mining Co. reports as follows for the year ended August 31, 1915: silver production, 2,036,963 oz.; revenue from ore, etc., $908,018 (decrease of $67,868); cost of production, $357,243; balance, $550,775; dividends, $620,000; deficit, $69,225; previous surplus, $961,093; present surplus, $891,868. Cost of mining was reduced from $5.09 to $4.15 per ton. Prospects of opening new ore are not considered bright. Reserves are estimated to contain 1,526,300 oz. less than before, the total contents being 4,172,400 ounces.

KOREA

The Seoul Mining Co. operating the Suan concession in Whang Hai province, reports the following results for September at the Suan mill:

Ore treated, tons	7,520
Mill worked, days	27
Recovery, bullion	$38,750
Recovery, concentrates	19,965
Total	$58,715
Operating expenses	$27,500
Net earnings	$31,215

The new 400-ton mill at Tul Mi Chung mine commenced full operations on September 30 and is working smoothly.

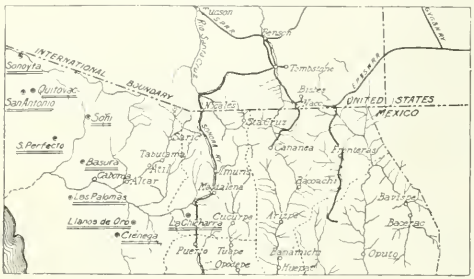
MEXICO

On October 13 Villa issued a decree ordering the American Smelting & Refining Co. to resume at its mines and smelters in the Chihuahua and Santa Eulalia districts by the 15th, or he would seize and operate them himself. Work was suspended at these properties several weeks ago, causing many unemployed. This probably vexed Villa, resulting in the threat.

Officials of the American Smelting & Refining Co. consider it too early to forecast results of the proposed recognition of Carranza by the A. B. C. powers and the United States. At present the company is doing nothing in Mexico. All American employees have been withdrawn, and in many cases plants are in charge of Mexicans. For the past two years full Mexican operations have not been attempted, there being only in-

termittent attempts to operate the various properties. Despite the long idleness, and the violence that has reigned, the plants have suffered little damage, and it is stated that claims against the Carranza government will probably not total more than $200,000. The various factions have shown no hostility against the company.

The principal problem confronting the company and all other American enterprises in Mexico, is transportation. For



ALONG THE INTERNATIONAL BOUNDARY.

three years no work has been done on Mexican railways, and tracks, rolling stock, culverts, and equipment are 'shot to pieces.' Many million dollars and a considerable period will be required to bring the roads to efficiency.

The A. S. & R. Co. has five smelters and about 30 mines in Mexico. Three of the smelters, in the south, are under control of the Carranzistas, while the two northern plants are in Villa territory. It is hoped Carranza will be able to consolidate this control over southern territory at least, and when this is done, attempt may be made to resume operations there, provided other conditions make it possible. The company has been careful to take no part in the struggle in Mexico, and has had no trouble from either faction.

The Southern Pacific Railroad Co. of Mexico, according to a reported statement made by Epes Randolph, its president, will present a bill of damages of $12,500,000 to the first stabilized Mexican government. He also said that when satisfactory political conditions obtain in Mexico the company will extend its railroad, now connecting Nogales with Guadalajara, 350 miles southward to Mexico City.

Sonora

At the Greene-Cananea two reverberatory and four blast-furnaces, and the mill are in operation. A flotation plant is being added to the latter. The September output was 3,514,000 lb. copper, 952 oz. gold, and 148,603 oz. silver, all considerable increases.

On account of the threatened trouble by Villa's army, the Moctezuma Copper Co. has ordered all its foreign employees to leave Nacozari. Calles states that he can easily defend Agna Prieta. El Tigre has not closed yet, and J. D. Malcolmson says that they will operate as long as possible, but bullion and stores have been sent to the border.

The better outlook in Mexico will also help greatly the United States Smelting, Refining & Mining Co., whose Real del Monte silver mines at Pachuca are only at 70% capacity. The Mexican employees have been loyal to the company. A shortage of lime has hindered ore treatment.

On October 9 the Montana section of the A. I. M. E. held its first dinner this season. The mineralization of the Boulder batholith was discussed by J. A. Grimes, of the Anaconda company, it being a continuation of the original paper by Paul Billingsley. This intrusion covers 70 mining districts and includes over 700 mines.

PERSONAL

Gardner Williams is on his way back to Washington.

George V. Mitchell has left London, going to Petrograd.

D. C. Bard has returned to Butte from British Columbia.

Courtenay De Kalb is returning to Tucson from New York.

Lewis Hind, of Hind & Johnson, at Oatman, was here last week.

F. Lynwood Garrison has returned to Philadelphia from Arizona.

C. C. Broadwater is now spending much of his time at Park City, Utah.

S. F. Shaw is now at the Dairy Farm mine, near Trent, California.

John M. Nicol has returned to San Francisco from Lewiston, in Trinity county.

Leo Von Rosenberg is examining mines in the Mother Lode region, California.

D'Arcy Weatherbe is sailing from New York by the *Rotterdam* on October 30.

Charles A. Banks, of the Jewel mine, British Columbia, is examining mines in Washington.

I. L. Fulton has returned from Willow Creek, Alaska, on his way home to Portland, Indiana.

N. Dickerman, general manager for the Pato Mines (Colombia) Ltd., is expected in San Francisco.

Charles T. Hutchinson, the business manager of the Mining and Scientific Press is visiting Denver, Chicago, and New York.

G. C. Bateman has resigned from the Canadian Mining & Exploration Co. to become field engineer to the La Rose Consolidated, at Cobalt.

F. Fukeda, mining engineer, with the Mitsu Bishi Co., is visiting the metallurgical works near San Francisco, preparatory to returning to Japan.

James C. Roberts, recently with the Bureau of Mines, has been appointed to the Joseph A. Holmes professorship of safety and efficiency engineering in the Colorado School of Mines.

Robert Marsh has been appointed general superintendent of the Nevada Consolidated copper mines, near Ely, Nevada. He was previously superintendent of the Braden mine, in Chile.

Louis Coderre, the Canadian Secretary of State, and head of the Department of Mines, has resigned to accept a judgeship, and is succeeded by Pierre Blondin, formerly Minister of Inland Revenue.

Thomas M. Skinner, Jr., has completed the chemical work pertaining to the waters of Owens lake, California, and has returned to Colorado where he is engaged temporarily with the Empire Zinc Company.

Obituary

Howard E. Burtin, president of the Western Zinc Oxide Co. and a prominent and respected assayer since 1890 at Leadville, Colorado, died on October 16 at Glenwood Springs, following five days' illness with pneumonia. Mr. Burtin went to Leadville in 1890 as assayer for the Elgin smelter.

Dennis Sullivan died at Denver, Colorado, October 10. He was well known in the West and had long been a business associate of Grant Schley in British Columbian and Mexican mines. He was also a heavy investor in the utilities companies of Henry L. Doherty & Co. and in other enterprises. Originally he mined in Gilpin county, Colorado, where he made his first stake, moving then to Denver, where he became profitably interested in public utilities. He was a shrewd but kindly man, and his death will be widely regretted.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, October 21.

Antimony	32
Electrolytic copper	19
Pig lead	5.00— 5.95
Quicksilver (per flask)	$92
Spelter	16
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	26

ORE PRICES

Antimony: market weaker, 50% product, free from deleterious impurities, per unit.....$1.40

Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....30.00

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, October 21.—Copper is quiet and weak, with a tendency to go lower; lead is very strong, with a strong demand for export; spelter has hardened considerably, spot is scarce.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	14	Sept. 8	48.20
"	15	" 15	48.56
"	16	" 22	48.85
"	17 Sunday	" 29	49.29
"	18	Oct. 6	49.64
"	19	" 13	49.55
"	20	" 20	49.53
	49.62		
	49.62		
	49.37		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The silver market is steady, with apparently a good undertone.

Pixley & Abell, London, state that offerings continue to be on a limited scale, while the chief support is for English coinage. The Continent has also contributed to the steadiness of the market. Both India and China seem disinterested as far as London is concerned, but the steadiness of China Exchanges is noticeable. As regards the Indian Bazaars, it seems probable that their present stocks will be sufficient for a while. In the immediate future the market may have to depend on the continuance of the present buying and may therefore be a little uncertain from day to day, but, so long as the offerings do not substantially increase, much change is not looked for.

Samuel Montagu & Co. consider that the general position is not unfavorable. The temporary cessation of purchase by the United States Mint may create dullness, but the feeling that there will be probable further purchases should maintain a good undertone. The withdrawal of gold from circulation, not only in England, but also in other countries, is good for silver, as there exists among some people an undoubted preference for silver coin over notes of low denomination.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Oct.	14	Sept. 8	17.62
"	15	" 15	17.42
"	16	" 22	17.75
"	17 Sunday	" 29	17.87
"	18	Oct. 6	18.00
"	19	" 13	18.00
"	20	" 20	17.87
	18.00		
	18.00		
	17.75		
	17.75		
	17.75		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended October 2 totaled 16,189,622 lb., valued at $2,965,857, 7,628,452 going to Russia, 4,686,763 to England, 2,576,804 to Italy, and 1,402,623 to France. Imports of all kinds amounted to 13459,307 lb., worth $2,131,339. Chile contributed 4,238,692; Canada, 2,145,644; Cuba, 1,982,400; Japan, 1,490,517; Spain, 1,317,678; and Peru, 806,402 pounds.

A good deal of Lake copper has been sold by a leading producer at 17.87c. per pound. Ahmeek has declared $2.50, and Osceola $3 per share.

The Granby output in August was 4,047,421 pounds.

Tennessee is to issue $3,000,000 first mortgage 10-year convertible 6% bonds. The company's capital has been increased from $5,000,000 to $6,875,000.

Copper shipments from Alaska for seven months totaled 32,880,582 lb., worth $5,635,258, against 12,819,459, valued at $1,902,281 in this period of 1914.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Oct.	14	Sept. 8	14.77
"	15	" 15	13.92
"	16	" 22	13.58
"	17 Sunday	" 29	14.23
"	18	Oct. 6	14.37
"	19	" 13	13.55
"	20	" 20	13.37
	13.25		
	13.25		
	13.25		
	13.25		
	13.50		
	13.75		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.39	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The New Jersey Zinc Co. has declared an extra dividend of $2 per share on the new capital of $35,000,000. On August 10 the quarterly of $2.50 was paid.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Date.	Week ending		
Sept.	22	Oct.	6
"	29	"	13
		"	20
	90.00		90.00
	90.00		92.00
			92.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

London quotes £16, equal to $76.80 per flask. A Consular report from Hongkong states that there is a big demand for mercury there, where it is used for making vermilion. Some cinnabar comes from Yochow, China.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	14	Sept. 8	4.90
"	15	" 15	4.63
"	16	" 22	4.50
"	17 Sunday	" 29	4.50
"	18	Oct. 6	4.50
"	19	" 13	4.50
"	20	" 20	4.50
	4.50		
	4.50		
	4.50		
	4.50		
	4.50		
	4.50		

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.22	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is quiet at 33.25 to 33.50 cents.

Eastern Metal Market

New York, October 15.

Copper, zinc, and lead have been disappointingly dull, and all show a tendency toward lower prices, such as is developed by pressure to sell. It is highly probable that quotations will drop a few points, at least, before buying ensues. The zinc market has been ragged both here and abroad, though there still exists the shortage of spot metal. The only feature in lead consists of some good export sales. Attention has been attracted to tin by the expectation that Great Britain will impose a duty on its exportation; a tax which the consumer must pay. Antimony is strengthened by the closing of the Panama Canal, and the interruption to traffic from the Far East. Aluminum, closely held and keenly sought for, has mounted to 55 to 60c. in ton lots.

The response of sterling exchange to the completion of the $500,000,000 Anglo-French loan has been disappointing. The rate has continued to improve and $4.68 was quoted on October 14. This compares with $4.50 on September 1, but a higher figure was expected.

The iron and steel trade shares none of the dullness witnessed in metals; on the contrary, the steel mills are struggling to make deliveries. The unfilled orders of the United States Steel Corporation showed a total of 5,317,618 tons, September 30, an increase of 409,163 tons, compared with August 31. On September 30, 1914, the unfilled orders amounted to 3,787,667 tons. The exports of iron and steel totaled 401,298 gross tons in August, 1915, against 86,598 tons in August, 1914. In eight months of this year they totaled 2,077,783 tons, against 1,046,347 tons in the same period of 1914. Exports of machinery and munitions are correspondingly large. Semi-finished steel is scarce and brings premiums. Plates, shapes, and bars are quoted at 1.40c., but a higher price is frequently paid, and the mills are unwilling to contract into 1916 at this figure.

COPPER

After remaining at the 18c. level for nearly three weeks, copper shows signs of weakening, and it is highly probable that a firm offer of 17.75c., cash, New York, would be accepted. Since the large export buying of over two weeks ago, the market has been flat, and in the absence of business quotations are practically nominal. Lake commands no premium over electrolytic. The London market in Standard copper is considerably weaker than it has been, but the metal itself has been steady at £88, the explanation being that American producers control electrolytic. Exports from October 1 to 16 total only 9913 tons. Following is a comparative statement of copper exports in long tons, from the United States during nine months of this year, as compiled by C. Mayer, secretary of the New York Metal Exchange:

	1915.	1914.
United Kingdom	60,458	63,498
France	68,915	48,530
Germany	.....	88,452
Holland	947	57,085
Belgium	.....	2,876
Austria	.....	13,809
Italy	31,415	11,995
Denmark	1,711	.....
Norway and Sweden	12,134	.....
Russia	9,171	125
China and Japan	108	1,640
Sundries	1,804	4,757
Total	186,663	292,767

In purchasing 3700 lb. of sheet copper, annealed, the Government Arsenal at Frankford, Pennsylvania, accepted the American Brass Co.'s bid of 21.25c. per pound.

ZINC

Continued lack of interest on the part of consumers has developed a weaker market, with considerable pressure to sell for delivery this month, although spot metal is still reported scarce. Prompt deliveries were offered October 15 at 13.25c., New York, and 13c., St. Louis. Shipments to the end of the year grade down to 11c., New York, and contracts for delivery in 1916 could easily be made at this price. The London market has also been weak, and on October 11 declined £3 10s. On the 13th it dropped another £1 5s. It is plain that at present prices galvanizers are not buying spelter, a fact which is reflected in the low state of activity of the galvanized-sheet trade. Exports continue at a good rate, those of the first 15 days of October aggregating 2295 tons.

Sheet zinc is unchanged at 16c., f.o.b. smelter, subject to a discount of 8% on cash for carload lots.

LEAD

Some good export orders have been booked, but otherwise the market has been quiet. The quotation of the A. S. & R. Co. has been steady at 4.50c., New York. The St. Louis quotation has been 4.42½c., but independent sellers are beginning to show a disposition to shade the Western price. At New York they have been content to meet the quotation of the largest interest, but at some other points they have undersold to a slight extent. Altogether the market has been uninteresting. Exports from October 1 to 16 totaled 1226 tons.

TIN

All interest in the tin market is centred in the continued idea that Great Britain will impose a 10% export duty on the metal, a report so seriously regarded by the board of managers of the New York Metal Exchange that it held a meeting on October 8, and adopted the following:

Whereas, it is reported that the question of levying an export duty on tin is now under consideration by the British authorities, the board of managers of the New York Metal Exchange declare:

That the provisions of the New York Tin Contract as adopted by the New York Metal Exchange, and the Rules of the Exchange, make it sufficiently clear and explicit that, in the event of such a duty being levied, it must be paid by the buyer unless otherwise specifically agreed.

Inasmuch as a fair number of contracts now operative have several months to run, it will be seen that the imposition of a duty will prove a serious matter for consumers, and many of them already have made protest based on a different construction of the rules of the Exchange. The situation has killed all business in futures. The only trading in recent days has been in spot and near-by deliveries, and there has not been much of this. There is a large stock of tin now in this country which would not be subjected to the tax, and should Great Britain make the expected announcement there will be a scramble for it. Arrivals this month amounted to 1675 tons, and there is afloat 4225 tons. Since October 1, the price has hovered between 32 and 32.87½c., touching the higher quotation on the 14th.

ANTIMONY

The blocking of the Panama Canal, holding up a large number of ships, acted quickly as a bull influence in the antimony market, and Chinese and Japanese became stronger, advancing to 28.50 to 28.75c., duty paid. Domestic antimony is offered at about the same figures. A special cable to the New York Metal Exchange on October 13 stated that the nominal price of Hallett's at London was £100 per ton (24c. per lb.), a quotation which had prevailed for some weeks.

COMPANY REPORTS

CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.

The third annual report of this, said to be the third largest zinc-producing company in the world, covers the year ended June 30, 1915. The mine and mill are in the Nine-Mile district, Coeur d'Alene, Idaho, and the output and profits during the past year have attracted much attention. The president and general manager is John H. Robbers, of Spokane; mine superintendent, C. W. Newton; and consulting engineer, D. F. Haley. The previous year's operation left a loss of $99,314, but the last year allowed of $697,597 being paid in dividends, and made a surplus of $1,094,862 at June 30.

Development during the past six months totaled 1510 ft., also 11,856 cu. ft. of stations and skip-chutes. No. 4 shaft was sunk 25 ft. to a depth of 485 ft. On July 1 there was blocked out above No. 6 level ore enough to supply the mill for 4 years.

Sales of products during the year were as follows: lead ore, 246 tons; lead concentrate, 2563 tons; zinc ore, 8473 tons; and zinc concentrate, 30,681 tons. The revenue from these totaled $2,146,283. All expenditure, including $79,550 on improvements, amounted to $569,404. From the profit of $1,591,773 the sum of $697,597 was paid in dividends. Assets total $1,151,642, and liabilities $56,780. The company's capital is 500,000 shares at $10 each, now standing at $21.

The mill has been re-modeled to treat 10,000 tons of ore per month. Flotation is used to aid recovery.

ORIENTAL CONSOLIDATED MINING CO.

The report of this well-known company, operating in Korea, covers the year ended June 30, 1915. The report is very complete, being 40 pages in length.

Nine mines were worked, all producing ore for the five mills. Development amounted to 37,214 ft., also 4532 ft. in prospecting on other claims, a total increase of 6819 ft. over that of 1913-14. Reserves are as follows:

Mine.	Tons.	Average value.
Tabowie to No. 15 level	550,000	$6.13
Taracol to No. 9 level	205,000	4.01
Chintui to No. 8 level	20,000	3.50
Kuk San Dong mines (3)	12,790	3.70
Charabowie to No. 12 level	45,000	9.27
East Candlestick	4,000	9.00
Tongkol	10,000	8.00

Results of development at the Tabowie, Chintui, and Charabowie were very good, at Taracol and East Candlestick were discouraging, while the Kuk San Dong mines were worked out.

The five mills with a total of 250 stamps crushed 297,889 tons in 230.42 days, averaging $6.55 per ton, yielding bullion worth $981,747. There was 33,177 tons of concentrate saved, yielding $643,571.

The total value of bullion recovered was $1,625,318; operating charges were $919,982 or $3.09 per ton; and construction, development, etc., $92,409; leaving a net profit of $660,095. Dividends amounted to $858,780, the excess over the profit being drawn from cash on hand, which now amounts to $447,018.

The Central American Mines, Ltd., of London, has issued a report covering the period from November 20, 1913, to December 31, 1914. The property is in Nicaragua. The output of gold and silver was worth $183,000. The 20-stamp mill only worked 56% of the time owing to power and treatment troubles. Costs were $7.32 per ton, but are now $5.32. Development was good, and large profits are soon expected.

BOOK REVIEWS

Handbook of Mathematics for Engineers. By L. A. Waterbury. Second edition. P. 213. Ill., index. John Wiley & Sons., Inc., New York. For sale by the Mining and Scientific Press. Price, $1.50.

The present edition is a few pages larger than the previous one, but errors have been corrected, and revisions made. New and important additions deal with hydraulics and reinforced concrete. The book, which is of vest-pocket size, is intended for reference, not for a text-book. Subjects are grouped under algebra, trigonometry, analytic geometry, differential calculus, integral calculus, theoretical, mechanics, mechanics of materials, hydraulics, and 105 pages of logarithm tables, etc.

Practical Surveying. By Ernest McCullough. D. Van Nostrand Co., New York. P. 395. Ill., index. For sale by Mining and Scientific Press, San Francisco. Price, $2.

There are many books on elementary surveying published every year. Usually they cover the subject fairly well and are much alike. The present volume differs from the general type in a few particulars. Important among these is a much fuller discussion of the retracement of old surveys than is usually found. This is commendable. Against this, may be set the fact that the mathematical tables are sprinkled through the book instead of being collected in a convenient place at either the front or the back of the volume. Also the work is not pocket-book size, and is bound in material that would not stand field usage. In fact, while the volume is a fair text-book, it is entirely unsuited for use in the field. A curious feature of the book is a short appendix on algebra.

Steam-Boiler Economy. By William Kent. John Wiley & Sons, New York. P. 709. Ill., index. For sale by Mining and Scientific Press, San Francisco. Price, $4.50.

Considerable attention has been directed to the fact that while there are a number of exhibits of internal-combustion engines at the Panama-Pacific Exposition, practically no attention has been paid to steam-engines. It has been suggested that while the internal-combustion engine is still in its infancy and new discoveries are being made every day, the steam-engine has become practically standardized and there are few new developments that are worth exhibiting. So, in the fourteen years since the first edition of this standard work appeared, there have been no remarkable developments in either the use or the design of steam-boilers, but there has been sufficient progress in details to justify a second edition. Greater efficiencies as well as higher duties are obtained than were the rule fourteen years ago, and the principal changes from the first edition deal with progress along these lines. Considerably more space is also devoted to oil as a fuel than in the former edition, although there are some statements as to the limitations of this use of petroleum that are more correct for the Eastern than for the Pacific Coast or Gulf States.

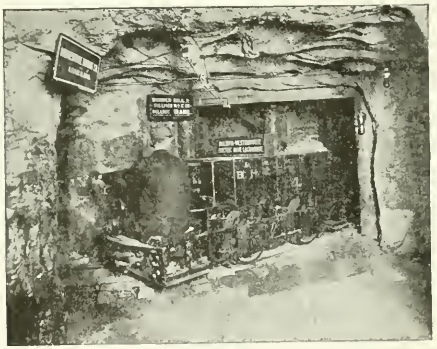
The general chemical and physical facts of combustion are first discussed and then the properties of different kinds of fuel. The next chapter is devoted to furnaces, methods of firing, and mechanical stokers. Boilers are then considered, from the plain cylindrical boiler up to the more modern types. Boiler-design and accessories to boilers are then taken up, and boiler-troubles. Methods and results of steam-boiler trials are discussed, and then the properties of steam and the design of chimneys. The last chapter is devoted to miscellaneous subjects. Perhaps the best way to describe the book is to say that it is as comprehensive for the present time as was the first edition, for the period when it appeared.

New Machines and Devices

Information based on letters and catalogues from manufacturers.

Electric Locomotives at the Exposition

The Mine in the Palace of Mines and Metallurgy has been described in the PRESS of May 1, 1915, also in several other issues. The absence of the mule is noticeable in this modern mine. In his place the visitor is shown the simple and efficient electric mine locomotive. There are two of these 'electric mules' shown, one in the metal section, of the storage-battery type 24-in. gauge, and the one in the coal section which is 42-in. gauge, and of the trolley, gathering-reel type. Both locomotives are of the well-known bar-steel frame construction of Baldwin-Westinghouse manufacture. The gathering-reel locomotive is of five-ton capacity, having two No. 903 motors for 250-volt service, and operates by means of the gathering reel in and out through a pair of automatic opening doors with a load of coal. This reel automatically pays out the cable on the outbound trip, and gathers it up on the return. The Westinghouse Electric & Mfg. Co., East Pittsburg, Pennsylvania, supplied all the motors used in the mine.



ELECTRIC LOCOMOTIVE UNDERGROUND.

Pumps at the Exposition

The large exhibit of the Krogh Pump Manufacturing Co., San Francisco, in the Palace of Machinery at the Exposition is attracting considerable attention. It consists of a varied line of centrifugal and turbine pumps of the most modern design. The principal exhibits are as follows:

One two-inch single-stage centrifugal pump direct connected to a 5-hp. motor, running at 1800 r.p.m. This pump has a capacity of 100 gal. per minute against a pumping head of 95 ft. It is set on four 1¼ in. steel balls on an ordinary wooden table, and special attention is drawn to the fact that this unit is not bolted down to any foundation, yet when working no vibration is perceptable, even though operated against a closed discharge. The Krogh automatic balancing arrangement, as embodied in all designs of Krogh centrifugal and turbine pumps, is absolutely fool-proof, needing no adjustment whatever, no matter what the condition of suction or discharge, and no set-collars or thrust-bearings are required.

Other pumps in operation are the Krogh deep well turbine of the regular and combination types. The particular features of these are that the rotating parts are carried by the automatic hydraulic water-balance, without the use of the usual heavy thrust-bearing at the top.

Another type that arouses interest is shown in the small vertical submerged type sump pump which is entirely automatic in operation.

The mining features of this exhibit are strikingly shown in the Krogh motor-driven sinking and station-pumps, Cornish and jack-head pumps, and the well-known Krogh slime and tailing pumps, all of which are well spoken of by large mining companies.

The exhibit is very complete, as it includes pumps from 26-in. size, with a capacity of 25,000 gal., down to those of about 10 gal. per minute, and for such varied uses as reclamation, drainage, fire-pressure systems, city sewerage, irrigating, mining and sugar factory work. The Exposition Jury awarded Krogh pumps several gold medals. The Exposition grounds and buildings get their entire water supply through Krogh pumps.

Commercial Paragraphs

The C. O. BARTLETT & SNOW CO., Cleveland, Ohio, has issued Bulletins 41 and 43. These deal with coal tipples and mining plants, and the Cabasco system of handling materials. The machinery is strong and of good material.

Bulletins 150, 151, 152, 153, 154, 300, and 104 of the A. S. CAMERON STEAM PUMP WORKS, New York, describe and illustrate ordinary, turbine, triplex, and other pumps manufactured for all purposes. They are all suitable for mine and mill work.

The CHICAGO PNEUMATIC TOOL CO. is distributing its Bulletin No. 216, covering its Hummer self-rotating type hammer-drills, which are made in three sizes, known as the A-66, B-66, and C-66 drills, suitable for drilling 6, 8, and 12 ft. holes respectively. Among the important features which the manufacturers have incorporated in their drill is that of the rotation of the steel being entirely independent of the hammer piston, eliminating the use of ratchet or pawl parts; and the valve which consists of a standard commercial hardened steel ball ordinarily used for ball-bearings. It is ⅝-in. diameter, and gives complete satisfaction. The firm has also issued *Booklet* No. 213, describing the new 'Simplate' flat-disc valve. It is simple, having independent plates and springs, the action being ideal under all speed conditions.

The Akins classifier is described in Pamphlet No. 24-B of the COLORADO IRON WORKS CO., Denver. This machine is giving satisfaction at about 40 large mills in this country. It consists of a trough, which is set at an inclination downward toward the slime-discharge, enclosing a revolving spiral or screw. The spiral is gear-driven at from 3 to 5 r.p.m. By the action of the screw the heavier particles of pulp settle to the bottom of the trough, and are gradually conveyed to the top end of the machine for discharge into a launder, etc., to be returned to a tube-mill or other part of the plant. The classifier is operated in closed-circuit with a ball or tube-mill. A 45-in. machine is handling 355.4 tons of pulp per day, containing 147.5 tons of solids. Moisture of the sand discharge is 22.7%, and 77.7% in the overflow, which contained slime 62.8% of which passed 200-mesh for flotation treatment. A lot of interesting matter is given in this publication.

EDITORIAL

T. A. RICKARD - Editor

MINING is essentially speculative, but it is a sane speculation, not like the gambling in war-stocks.

FUNDAMENTAL business conditions are better now than at any time since 1912. The revival of industry continues to spread. And yet the factor of abnormality, in so far as the War has stimulated certain manufactures unduly, must not be ignored.

WHEN Mexico is put in order and re-opened to peaceful industry, it will be a great day for the mining profession. There is now so much money available for new business in America that there would be no difficulty in financing fresh enterprises or resuming mining and smelting operations on a generous scale.

IN the latest circular of the Mining and Metallurgical Society it is stated, by the secretary of the New York section, that the MINING AND SCIENTIFIC PRESS re-published in full the remarks made by Mr. J. R. Finlay on 'Industrial Efficiency as a Military Weapon.' Not only did we not do so, but we stated explicitly, in our issue of August 14, that, owing to prejudices arising from the War, we deemed it unwise to discuss the problem. We learn from New York that the error was quite inadvertent and that our Denver contemporary, now deceased, was the periodical to which reference should have been made in regard to the re-publication.

VARIOUS estimates have been made of the amount of copper used in cartridges by the hosts of the belligerents; one is that if 8,000,000 soldiers are in the field, each with 400 cartridges, they would account for 44,800 tons of copper, which is 25% more than the estimated stock of the metal in Europe on the eve of the War. Including copper in shells, the total amount would be equal to the whole stock available in both Europe and America just before hostilities began. Another estimate places the consumption of copper at the present time on the European battlefields at 230,000 tons per annum or about 20% of the world's total production.

RAY and its copper is discussed in an interesting letter contributed to this issue by Mr. Frank H. Probert. The question of valuing these copper mines in Arizona is timely, having regard to the incorporation and flotation of another enterprise in the same district, namely, the Ray Hercules Copper Company, which now controls the Arizona Hercules property, belonging formerly to Mr. W. P. Dunham. The orebody has been drilled at intervals of 100 feet, disclosing 3,400,000 tons of 2.36% copper ore in an area of 13½ acres, out of 207 acres owned by the company. This appears to negative a geologic forecast, for Mr. J. E. Spurr insisted that no ore would be found west of the Ray fault. That, however, was at a date when all the necessary evidence may not have been available. Three-quarters of the Ray-Hercules ore is in diabase, in ground so wet as to handicap the application of any ordinary caving system. This fact will test the resources of the capable manager, Mr. C. E. Addams, who was formerly at the De Beers diamond mines at Kimberley, and lately assistant superintendent at the Ray Consolidated. The enterprise starts under good auspices and should prove a notable addition to the disseminated copper mines of the West.

MEXICAN affairs progress slowly. An embargo on the American export of arms and ammunition into Mexico has been put in force as against everybody except the *de facto* Government, the recognition of which has already caused numerous desertions from the Villa forces. It is stated that the corn harvest is 60% short of normal, so that much misery is certain during the coming winter, unless the restoration of order stimulates the importation of food-stuffs. Mexico, of course, is bankrupt. Claims for damages will amount to a colossal sum, hundreds of millions. A commission to inquire into this matter is to be appointed by Carranza. A big bond issue, secured by customs duties and internal taxes, will have to be made as soon as the Government forces have crushed the Villa and Zapata factions. Meanwhile conditions in northern Mexico are more uncomfortable than ever, pending a decisive engagement between Villa's troops and those of the Government. But there is every reason for believing that Villa's adherents will shortly be scattered and that he will seek safety on this side of the Rio Grande. Then we may expect a general revival of mining in the northern region, to be followed by a resumption of activity southward as soon as railroad communication is restored.

IN the Minerals Separation *v.* Miami suit recently it was stated that, besides the Miami, those infringing upon the alleged patent rights of Minerals Separation were the Utah Copper, Nevada Consolidated, Nevada Mining & Smelting, and the Magma Copper companies. This, however, we venture to add, is not a complete list. In the case, now under adjudication, the counsel for the plaintiff asserted that the infringing companies "let $17,000,000 run to waste in one year, 1913, before they knew of our [the M. S.] last invention." He also stated that the extraction by wet concentration was only 63 to 71%, "whereas Anaconda and Inspiration [using M. S. patents] extract 85 to 95% at no greater cost of plant

or of operation." He then proceeded to disclose the terms arranged by Minerals Separation with the Anaconda and Inspiration, namely, that these two companies have guaranteed that if the Supreme Court reverses in the Hyde [or Butte & Superior] case, or if they do not exercise their option to surrender their license in case of affirmance, they will treat 25,000,000 tons of ore by the Minerals Separation process by 1923, and will pay the agreed royalty thereon, this royalty we understand being ⅔ cent per pound of copper, but not less than 12 cents per ton of ore; and meanwhile, whatever the decision of the Supreme Court, they have agreed to pay a royalty of $300,000 to Minerals Separation within a year. Undoubtedly the improved returns at the Miami are due largely to the use of flotation. When the management of the Inspiration had completed plans for the erection of a new wet-concentration mill, it was decided to make some tests in flotation, which was found to promise an extraction at least 10% better. Whereupon an experimental plant was erected and thorough tests made, with the result that the original mill-plans were discarded and a new design involving the use of flotation was adopted. We understand that the extraction in the new mill, using flotation, is fully 15% better than that obtainable by any of the older methods.

OFFICIAL notice has been given that the Australian Metal Exchange was established as from September 6 and all metal-trading with persons outside the Commonwealth must now be conducted through the Exchange, which is under Government control. This is one of the by-products of the War. It is due largely to the disclosures made during the Snow trial. Another illuminating case came recently before the Prize Court in London, when Henry R. Merton & Co. made a claim on the British Government on account of freight paid for a shipment of zinc concentrate from Broken Hill consigned to them by the Australian Metal Company, one of their affiliated concerns, and seized by reason of its enemy destination, namely, the Metallgesellschaft of Frankfort, Beer, Sondheimer & Co. of Frankfort, and Aron Hirsch & Sohn of Halberstadt, all in Germany. In giving judgment, the Court said that the Merton company was intimately associated with the Australian Metal Company and two of the German firms mentioned. Lack of good faith with the British Government was imputed to the Mertons, important letters to these German firms having been withheld, until the office of one of them was raided. The Judge said that their claim "required much assurance, and to persevere in it showed a reckless want of appreciation of the possible consequences. Messrs. Merton & Co. did not hesitate to engage in commercial intercourse with the enemies of this country in their desire to get the goods for an enemy firm." Our readers will learn with amusement that the firm of Henry R. Merton & Co., which includes several British partners—although the name Merton was changed from Cohen—has acted as metal-buyer for the British Admiralty and has been gravely consulted on kindred matters, such as nickel imports. These disclosures confirm the accuracy of our diagnosis of the nexus of metal-selling agencies that has endangered the welfare of the mining industry. Not because it is German, but because it is a combine in restraint of fair trade in the metal-markets of the world, we object to the secret interplays of this international coterie.

CORNISHMEN all over the world will be interested to learn that the Tehidy Estates of Mr. G. L. Basset have been sold to Mr. Hamilton Edwards, formerly manager for the Amalgamated Press. This property embraces the mineral rights to a number of famous Cornish mines, including Dolcoath, Carn Brea & Tincroft, East Pool, and South Crofty. These mines pay 'dues,' or royalties, on their gross output of tin to the 'mineral lord' or land-owner. Dolcoath alone has paid $850,000 in dues to the Basset family during the 19 years of the present company's life. It is announced that the new proprietor is prepared to discuss the compounding of these obligations "on quite moderate and reasonable terms." Another item of interest is the appointment of Mr. Herbert Thomas as mining representative of the new owner. Mr. Thomas is the vivacious and energetic editor of *The Cornish Post;* at one time he was on the staff of the San Francisco *Examiner*, but he has outlived that handicap and become a journalist of high character. Undoubtedly the selection of a man so closely in sympathy with Cornish mining as the agent for the new owner will go far to assure a satisfactory adjustment of a burden that has been felt keenly by the mining companies tributary to the Tehidy estate.

Labor and Capital

In our last issue we made reference to recent strikes, more particularly the one now in progress in Arizona. Such labor disturbances, it may be confessed, often find the members of the mining profession in a difficult position, between the devil and the deep sea. Any thoughtful and observant man cannot help becoming aware that the rights and wrongs of the quarrel are confused. For instance, while it may appear perfectly justifiable for the managements of mines to refuse to negotiate with their employees when the latter have put their case into the hands of an outside organization so stained by crime as the Western Federation, it does not seem reasonable to object either to the formation of a union among the employees or an affiliation of that union with a national organization of the same kind, namely, a legitimate combination for the purpose of collective bargaining. Of course, the mining company itself is a union or combination of owners, the stockholders; moreover, the companies in the same district agree, through their managements, to act as a unit in labor matters and sometimes they extend their co-operation over wider areas. In the big strike at Johannesburg two years ago the refusal, for instance, of the management of the Kleinfontein mine, where the strike began, to deal with any labor representatives not in its employ, was supported by the claim that the Kleinfontein management was acting

alone, without agreement or support from the neighboring companies. That was humbug. The managements of the big groups of mines supported one another loyally and were in close agreement as to their labor policy. Such co-ordination of interest is logical and inevitable. That being so, to attempt at this late date to deny any group of men, laborers or capitalists, the right to combine in legitimate self-protection is futile. Collective bargaining has come to stay; it is one of the results of business expansion, involving large numbers of laborers on one side and large numbers of employers on the other side. The joint-stock company typifies the combination of capital just as the union represents the solidarity of the labor element. Unfortunately, with an increase in the scale of operations has come a loss of personal contact between employer and employee, tending to dehumanize the relationship between them. In both the Michigan and Transvaal strikes one of the complaints was that the bosses subjected the men to petty tyranny and unfair discrimination, sowing the sure seeds of resentment.

Undoubtedly the multitudinous character of modern industry tends to obscure the rights of the individual unless he combines with his fellows, so as to compel consideration from those in authority. On the other hand, the contract between labor and capital, that is, the agreement to abide by fixed terms of employment and payment, is one-sided; capital gives bonds, as it were, for it has property that can be destroyed and a business that can be disintegrated during the period of a long and violent strike; moreover, a company can be sued for infraction of contract and punished for nonperformance by being mulcted in damages; but a labor-union is here today and gone tomorrow, it has no property to stand sponsor for its word, it has a personnel of shifting parts, it gives no security for the fulfilment of its pledges. Hence agreements between managements of companies and masses of employees, especially if the latter be of alien origin and illiterate, as is largely the case in Michigan and Arizona, are of little use in establishing enduring peaceful relations. That consummation would be more likely if the community—by its legislature—insisted on labor organizing itself on permanent lines, with a registered office and financial responsibilities, so that the property rights behind both capital and labor could stand surety for the observance of their mutual agreements. The funds or other property of a union should be as much jeopardized by the breaking of a contract as the funds or other property of the joint-stock company. Of course, the laborer that puts money into the treasury of his union is just as much a capitalist as the stockholder in a mining company. The community should insist that both 'play fair.' If a union breaks its agreement, it should be outlawed; so also a company guilty of similar turpitude should suffer an equal penalty, involving the inability to operate in the State the laws of which it had broken. The community as a whole suffers from the acts of both parties in these industrial quarrels and it should see to it that both behave themselves.

Behind all this we come to the basic fallacy of the labor propaganda. Of course, labor has a right to combine for self-protection. Every thoughtful man must concede that. But the next most important tenet of unionism, that men shall receive an equal wage irrespective of individual efficiency, is contrary to economic justice. The day's pay system, with a minimum wage that is nearly a maximum, is grossly unfair to the employer, particularly when accompanied by a persistent effort to reduce the hours of work. If all men worked steadily and honestly, eight hours would be enough, and more than enough in some kinds of employment, but the insistence on paying the same wages to all laborers regardless of their efficiency, to the man who really works eight hours and to the man who wastes two hours out of the eight in one way or another, is unfair; it is an economic wrong, just as much, for example, as the attempt to perpetuate a scale of wages irrespective of a change in the cost of living. An escape from the anomalies and stupidities of day's pay is always open by recourse to the contract system, whereby a man is paid in accordance with his accomplishment. But systems of working on contract can be abused like any other; to be successful it is essential that the manager or superintendent shall not try to take advantage of his men. And that, after all, is the crux of the whole matter. It is the effort to impose upon one another that upsets the delicate relation of employer and employee. That relation becomes more delicate as men gain intelligence and initiative. A native-born American makes a poor valet; a democrat makes an unquiet serf. Some men must work with their heads, and others with their hands; so long as one man hardly knows his right from his left, while another can orient himself wherever he may be, so long "witless will serve his master"; but the relationship can be made endurable for both and beneficial to the social organism if mutual consideration is united to a sense of fair play.

Who Owns A Report?

A recent episode provokes an enquiry into the ownership of reports on mines and the delicate questions of conduct in the giving of information obtained by an engineer in the course of examining a mine for a client. Let us state the case. An engineer is retained by a client to examine a mine and to report thereon, with particular reference to the purchase or sale of the property for a stipulated sum. The report is duly made and transmitted to the client. Does the copyright of that report belong solely to the client? Has the engineer parted with his entire ownership in the report? Can he show it to another client or can he actually sell the report to somebody else? Let us answer some of these preliminary queries, as to which we are largely in agreement, in order to clear the way for some more difficult problems. We take it that the members of the profession will agree that if Mr. Dash retains Mr. Blank to advise him on the sale or purchase of a mine for a given sum, then the advice given by Mr. Blank is confidential. To nobody save Mr. Dash should it be disclosed. It is private business.

Next, the advice in such a case involves the appraisal of a mine at a specified date; that information also is private, and, having been transmitted to Mr. Dash, belongs to him alone. For how long? If Mr. Dash drops the business and is no longer interested in the affair, can Mr. Blank use the information, for instance, in advising another client as to the purchase of this particular mine or of another in the vicinity? How long has Mr. Dash got a copyright on the report and the information therein contained? In perpetuity? Then if Mr. Blank were to report on a mine every time he went to a mining district all the first-hand information in his head would be labelled with the names of his various clients and there would be a water-tight partition between each cerebral record—in short, Mr. Blank would be no better off than if he had water on the brain: his mental equipment would be under a perpetual mortgage. Obviously there must be a limit to the placing of an embargo on the information obtained by an engineer in the course of an examination and given by him in the text of his report.

Our readers may suggest that the opinions expressed in the report, more particularly the actual appraisal, belong to the client but the general information that the engineer may have gathered concerning the mining district, in which the mine is situated, remains at the disposal of the engineer. But some kinds of knowledge, as to faulting, as to the trend of an orebody, as to the treatment of the ore, may be as valuable to the client as the appraisal itself, in case the latter should be a promoter or financier intending to transact business in the same district. If it be granted that all of this also belongs to the client, then again comes the question, until when? Has he a lien on all such knowledge indefinitely, and must the engineer make no use of it during the term of his natural life?

If the client informs the engineer that he has dropped the business, is the engineer free then to use the information, to the point of selling the report to another client? Does the fee thus obtained, as a result of his first client's retainer, belong to the engineer or to the first client or should they divide the proceeds? Suppose, on the other hand, that an engineer is commissioned to make a general inspection of a district, without reference to a particular property, and thus gathers a lot of varied data; is the engineer to be denied the use of them subsequently? If not, what use can he make of them? Can he employ them in advising another client in regard to the district as a whole or in reference to a particular mine? Can he publish an article in a technical journal describing this district and embodying much of the information obtained at the expense of his client? What right has the client to prevent him from taking such advantage of the information, more particularly when the client himself has decided not to act on the report? Can the client play dog-in-the-manger indefinitely? Finally, if an engineer has been in the employ of a mining company, is he entitled to write—not on the affairs of the company itself—but on the technical methods applied in that company's operations, with a view to being useful to the profession and of gaining such personal distinction as comes from writing intelligently on technical matters? Has the company any right to close his mouth or forbid the play of his pen—on non-private aspects of its operations—until the crack of doom? To put it even more bluntly, can a client acquire a prior lien on an engineer's brain by paying him a fee? Is that lien without limit of time? To this we need only give the analogy of the architect. When he prepares plans for a client, he retains the copyright. The client has the use of the plans, for a fee, but he does not buy the sole copyright to them, they remain the property of the architect. The latter will not build a second house just like the one shown in the plans and the client is not supposed to sell those plans to a second man. Similarly the lawyer regards his brief, in so far as it concerns his client's personal affairs, as private, but he deems himself free to quote or to publish such portions of the brief as deal with general principles of law and citations pertinent to a subsequent case. Sundry conventions exist in such matters, and beyond the conventions come ideas based on fairness and reasonableness, culminating in that indefinable regard for the eternal proprieties called good taste.

We leave these delicate problems with our readers, hoping that some of them will express their opinions. This is a matter of professional conduct, not to be regulated by any law or regulation. It will be well to elicit the considered opinion of the profession as a guide for those who may be uncertain what course to pursue. We shall be glad to hear from the older practitioners with experience in such matters. We invite the younger men also to have their say. In such matters the young are apt to have clear perceptions. As men grow older their sense of propriety may become calloused; in the rough and tumble of the hard arena of financial conflict, the man that 'puts it over the other fellow' is forgiven for many things that a healthy-minded young man would disdain and condemn. Success excuses much that is despicable. The 'double-cross' is overlooked if it spells a fortune. For these reasons we would like to hear from the younger men, with ideals not yet blunted by greed, with a code of conduct not yet shattered by an unscrupulous ambition. Yet we recognize that the decisive opinions must come from those who have faced the problem in the course of their work as consulting engineers. A report on the facts of life is needed. No laws regulate these matters; they are left to the correction of events. If an engineer outrages the feelings of a client, and the client is deemed not unreasonable by fair-minded men, then the engineer suffers in his practice. If an engineer with a reputation yet to make interferes with a powerful promoter's scheme, the enmity of the latter may prove a serious factor. Unscrupulous financiers and domineering operators can make it hard even for a well-intentioned and straight-dealing practitioner not financially independent. Such brutalities cannot be wholly checked, but the crystallization of a healthy public opinion can do a great deal to regularize these questions of conduct. Before opinion can be crystallized, it must go into solution. Let it be dissolved in common sense and that uncommon sense—the sense of honor.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Valuation of Metal Mines

The Editor:

Sir—At the recent meeting of the International Engineering Congress held in San Francisco, several important papers were presented dealing with the valuation of mineral lands. These should have provoked a lively discussion, but whether on account of small attendance, reticence on the part of those competent to express opinions, or lack of time owing to the necessity of closing the session to attend other meetings, the most valuable contributions to the proceedings were read by title or summarily dismissed in the briefest abstract.

Mr. T. A. Rickard's paper on 'The Valuation of Metal Mines' outlined the methods of appraisal of mines for taxation, citing the very satisfactory work of Mr. J. R. Finlay in the Lake Superior copper and iron districts and Mr. W. L. Uglow's later assessment value of the Wisconsin zinc mines, which apparently lacks in any substantial premise.

Mine taxation has been the cause of much wrangling between State officials and mine-owners in Arizona, although Mr. T. E. Campbell, the State Tax Commissioner, is exercising every effort to formulate a just plan on which mines shall be taxed. The ways and means of the several State tax commissioners should prove of value to those of your readers who are interested in mine valuation.

The mining of large orebodies and the beneficiating of contained metals is just as much a manufacturing business and subject to the same laws as govern other commercial enterprises. The raw material can be definitely appraised, all steps to the finished product analyzed to ascertain an average cost of production of the saleable goods; market conditions, cost of plant, capitalization of the company, life and amortization, all these factors may be determined with a degree of accuracy such as to reduce the purely speculative side of mining to a minimum. The days of the old mine promoter are numbered; capital is interested in the measurable masses of a commercially mineralized deposit rather than in the phantom profits of glaring prospectuses.

In the April 1914 issue of the *Mining Magazine*, attention was called to the tendency of the times in the consolidation of properties and management by the successful few. Of recent years the Utah Copper has absorbed the Boston Consolidated and merged with the Nevada Consolidated; Inspiration and Live Oak have been linked into the Inspiration Consolidated; Ray Consolidated and Ray Central have been joined; the Calumet & Hecla has taken over a number of subsidiary companies and more recently Amalgamated and Anaconda were put together. These transactions were not conducted as cash sales but by re-organization, the issuance of new stock and absorption on the basis of relative values.

To arrive at the relative value of properties under like conditions in the same district, for purposes of consolidation, is a branch of the subject of valuation seldom discussed; the shareholders are advised of the ratio of exchange offered without knowing how the figures were obtained, with the inevitable result that minority interests are often disgruntled and air their supposed grievances in the courts, or temporarily delay progress by recourse to any of the thousand and one legal demurrers at their command.

There are many factors in the equation and no general algebraic formula can be given applicable to all cases. Every mine, like every human unit, has its idiosyncracies; every district its peculiarities. An intimate knowledge of local conditions is requisite. An experienced engineer will weigh carefully all the evidence before figuring. Consolidation may be deemed advisable for many reasons, such as, control of territory, increased tonnage, better facilities for operating, unification of systems, avoidance of litigation, maximum output at minimum cost, reduction of taxes, desirable mixture of ores for smelting, lessening of overhead expense, etc., etc. The object sought will determine the method of procedure. A concrete case of relative valuation merits description.

In 1907 the Ray Consolidated Copper Co. was organized with 600,000 shares, par value $10, to take over the properties of the defunct English company, at Ray, in Pinal county, Arizona. In 1910 it absorbed its younger neighbor, the Gila Copper Co., on a basis of a 1:3 exchange of stock, increasing its capitalization to $14,000,000. In 1912 still another re-organization was effected by the acquisition of the Ray Central Copper Mining Co. at the ratio of 1:8 and the issuance of an additional 200,000 shares of stock.

Ray Consolidated had measurable ore reserves aggregating 77,314,000 tons of an average assay of 2.17% copper. Ray Central had blocked out in 100-ft. sections, 6,711,000 tons running 2.19% copper and a 'high-grade' orebody dissected by 50-ft. drifts and cross-cuts of 673,000 tons at 5.83%. The Ray Central tonnage was determined from the assay-plans and vertical sections along north-south and east-west co-ordinates at intervals of 100 ft. Upon each of these the limits of the orebody were sketched, having in mind the system of mining to

be adopted and the accepted assay-limit of value. For convenience the property was divided into block-units of 200 feet. The prismoidal formula was used, separate computations being made for north-south and east-west co-ordinates and the average accepted. The geometric assay-average was calculated, all assays being weighted according to the number of blocks in which they were used. The total tonnage given was the total of individual blocks and the general assay-value was computed, using factors for block-averages according to tonnage. This method of estimating was fully described in the *Engineering and Mining Journal*, December 16, 1911. Equally satisfactory methods were employed by the Ray Consolidated engineers.

The ore reserves of Ray Central were confined to two isolated fractional claims of 29.93 acres, forming a wedge between the old Ray Consolidated and former Gila holdings. The ore-horizon is continuous through each property. The main levels of Ray Consolidated and Ray Central were driven at the same elevation; the ore was developed in each case to the common property-lines. Geographically, geologically, and economically the two properties belonged to one company. The advisability of consolidation was obvious to all.

In mining separately there was the danger of trespass beyond boundaries and damage to property. Mr. Louis S. Cates, representing the Ray Consolidated in the negotiations, estimated that 35% of the Ray Central low-grade ore would have to be left to support the lateral boundaries on a 60° caving line. He also figured that Ray Consolidated would forfeit nearly two million tons if the companies operated independently.

To recognize the surface claim-lines as the limits of mining possibilities would have been more serious to Ray Central, because the greatest thickness of proved ore was at the common south boundary. Even though a decision at court were granted to either claimant for trespass, the difficulty of appraising damage and attendant ill-will would mitigate against the success of operations.

The question of proportionate drainage-cost had to be considered and still more important was the threatened damage to the Ray & Gila Valley railroad, which crossed the Ray Central claims above the high-grade orebody. Owing to the topography of the land, no other practical route offered to connect the divided Ray Consolidated orebodies. Development of water and power, transportation of supplies and products, all these were vital factors. The Ray Consolidated was a producing mine, fully equipped to handle large tonnage; the Ray Central was thoroughly explored, its possibilities well defined, but it lacked adequate mine and mill equipment. I figured that to make Ray Central a steady producer (1500 tons daily) would cost $1,400,000 and consume 18 months. The banking phase of the situation was discussed by the directors and the relative advantages and drawbacks of unified or independent operation thoroughly thrashed out.

It was finally decided to appraise the properties on the relative net valuation of tonnage developed, setting aside the fact that $9,000,000 had already been expended by Ray Consolidated in the acquisition of property and the development and equipment of same; that the added tonnage of Ray Central would proportionately displace ore from the larger mine—which meant deferred realization of assets. The records of each company were open and the respective engineers acted in pleasant co-operation. Tonnages were checked, assays confirmed, costs studied, interest and amortization figured, and in the end there was practically a complete transfer of Ray Central stock on the basis determined.

	Ray Central.		
	High-grade.	Low-grade.	Ray Consolidated.
Tons of ore	673,000	6,711,000	77,314,000
Assay, percentage of copper.	5.83	2.19	2.17
Mine recovery, per cent	95	90	90
Tons recoverable	639,350	6,039,900	69,582,600
Net recovery at mill, per cent	85	70	70
Copper per ton of ore milled, in pounds	99.1	30.66	30.38
Concentration ratio	8 to 1	18 to 1	18 to 1
Copper per ton of concentrate, in pounds	793	552	547
Net recovery at smelter, per cent	95	95	95
Smelter yield per ton of concentrate, in pounds	753	524.4	519.6
Smelter yield per ton of ore, in pounds	94.1	29.1	28.9
Refining and marketing, at 2c. per unit, per ton of concentrate	$15.06	$10.49	$10.39
Smelting cost per ton of concentrate	6.00	6.00	6.00
Total smelting cost per ton of concentrate	21.06	16.49	16.39
Total smelting cost per ton of ore	2.63	0.916	0.91
Estimated mining cost	1.50	0.75	0.75
Estimated milling cost	0.55	0.50	0.50
Transportation, mine to mill, per ton	0.18	0.18	0.18
General expense	0.05	0.05	0.05
Total cost per ton of ore	4.91	2.396	2.39
Cost per lb. copper	5.218	8.234	8.27
Profit per lb. (copper at 14c.)	8.782	5.766	5.73
Total lb. copper recoverable.	60,163,000	175,761,000	201,094,000
Total profit	$5,283,500	$10,134,000	$115,226,800
Daily output of ore, tons	400-500	1,000	10,000
Life of mine, years	4	17	20
Annual profit	$1,320,875	$596,100	$5,761,350
Hoover's factor, at 7%	3.27	8.91	9.65
Present value of contained copper	$4,319,300	$5,311,250	$55,597,000
No. of shares outstanding	1,900,000	.....	1,350,000
Intrinsic value per share	$2.27	$2.80	$41.18
Total value per share	$5.07		

Relative value of stock, 8.1 shares Ray Central to 1 share Ray Consolidated.

The high-grade orebody of Ray Central was an inducement. From 400 to 500 tons per day was quickly available and Mr. H. Kenyon Burch, the consulting mechanical engineer, had estimated an extraction of 85% of its contained value. The production of copper from this source would make a favorable showing when some

stimulus was needed to the market. It was a quick live asset at a time when the grade of the average ore of the district was low, owing to the caving of surface stopes and consequent dilution due to admixture of capping and oxidized material.

Representing Ray Central, I used the following method in determining the proper ratio of exchange. (See tabulation). At a stockholders meeting, in June 1912, the Ray Central ratified the action on a basis of eight shares of Ray Central for one share of Ray Consolidated.

The term 'Hoover's factor' is taken from Mr. H. C. Hoover's 'Principles of Mining,' Table I, page 46. The present value of contained copper represents the amount that will be repaid out of the profit assured, together with 7% interest, when the annual payments into sinking fund earn 4 per cent.

This transaction took place in 1912. It is interesting to compare the estimates with actual figures as given in the sixth annual report of the Ray Consolidated Copper Co. just issued. The production for 1914 was 59,044,700 pounds of copper from high-grade crude ore and concentrate. The smelter recovered 57,004,281 lb., or 96.6%. The average net price received for copper was 13.26 cents. A re-calculation of tonnage, based on more recent underground developments, gives 74,765,789 tons averaging 2.14%, but from former estimated tonnage, 7,061,821 tons at 1.74% has been mined. It must be remembered that this ore comes from the top and irregular fringes of the proved orebody, so that it is partly oxidized and diluted with capping. It does not represent the true run-of-mine. This explains the apparent discrepancy in grade between that estimated and actually mined to date.

Owing to the fact that the mine is now in good working order, the daily output is maintained largely from the reserve drawing of stopes, thereby considerably lessening the mining cost of former years. The total mining cost for the year was 62.42 cents.

Selective stoping of the high-grade orebody was adopted, so that comparison with my estimated cost is not possible. Sorted ore to the amount of 2591 tons averaging 11.86% was shipped direct to the smelter, the remainder going to the mill. Square-setting and waste-filling bring the cost up to nearly four times the average of all the ore mined.

A daily average of 6651 tons of ore, assaying 1.76% copper, was milled throughout the year, but the output was curtailed to one-half normal from August to December. The average recovery was 67.88%, or 23.9 lb. per ton. This would have been better but for the remodeling of the mill during the period of curtailment. The cost of milling was 49.88 cents. The average grade of concentrate was 19.25% copper, a concentration ratio of 16 into one.

The cost of production was 8.839c. per pound, which includes all operating and general expense as well as 12½c. per ton of ore milled applied to the retirement of mine-development cost. Crediting all miscellaneous income, the net cost per pound was 8.763 cents. These figures show a net profit of 4.497c. per pound copper produced, or $2,563,480 for the year.

San Francisco, October 2. FRANK H. PROBERT.

Why Is Flotation?

The Editor:

Sir—Mr. Durell's article on this subject in your issue of September 18 is interesting. I believe that an exchange of ideas on this subject is very desirable, and it may be that some of the information that I have collected may be of interest to the readers of the PRESS.

The arguments which Mr. Durell's article presents are, briefly, that floatable particles cannot attach themselves to previously formed bubbles, but must be floated by bubbles which form themselves on the surface of the particles so that there is no surface film of water between the particle and the air. To explain the formation of these, Mr. Durell assumes that the water is super-saturated with dissolved air and that there is a certain amount of "occluded" air on and in the surface of the particle, and that these combine to form bubbles. That this occluded air may be present is certainly possible, but that it would be liberated with sufficient rapidity to float the particles does not seem probable. That the water in a M. S. type of machine is super-saturated with air is also probable, but I cannot see how the water in a Callow or other pneumatic machine can become greatly super-saturated by the introduction of air through a coarsely porous medium such as canvas twill.

The idea of super-saturating the water with air is not new. As early as 1907 D. H. Norris patented this process. (U. S. patents No. 864,856 and 873,586.) Mr. Norris saturated water with air at a pressure of several atmospheres, and introduced it into an open tank at normal pressure, where the excess air formed what he called "infinitely small nascent bubbles of gas" which were supposed to float the sulphide particles. So far as I know, this idea has never been put into successful operation.

As to Mr. Durell's statement that the dissolved and occluded air are indispensable; if it is true, previous boiling of the pulp, which would drive out all of the dissolved and some of the occluded air, should interfere considerably with flotation, especially in a pneumatic machine. I have seen this done in the laboratory of the General Engineering Company. The subsequent flotation took place with practically the same rapidity and cleanliness as when the same ore was floated without boiling of the pulp. Furthermore it has been my observation, that when a carbonate ore is treated with soluble sulphides for the purpose of forming an artificial film of sulphide on the surface of the mineral particles, much better results are obtained when a small amount of alkali is added to the pulp to remove any traces of H_2S gas. This can also be accomplished by the use of SO_2, which reacts with the H_2S to form sulphur and H_2O, and does not leave an alkaline pulp. Were Mr. Durell's hypothesis true, this gas should be beneficial rather than detri-

mental, and it would seem that the general effect of artificial sulphiding would be to reduce the amount of occluded air rather than increase it, as some of it would undoubtedly be displaced by H_2S which would later be removed.

I cannot agree with Mr. Durell's statement that floatable particles will not attach themselves to previously formed air bubbles. I understand that in the suit of the Minerals Separation, Ltd., *v.* Miami Copper Co., heard at Wilmington last May, the plaintiff presented to the Court a moving picture of an experiment in which it was shown under just what conditions the particle would attach itself to the bubble. Aside from that, it is not a far-fetched assumption that the air bubbles in an oil-emulsion have mantles of oil. Their property of frothing would so indicate, and, in that case, the surface films of water surrounding them would not differ materially from the films surrounding drops of oil suspended in water. That such drops of oil can collect floatable particles out of an ore can easily be proved by shaking oil with a mixture of galena and sand suspended in water. When the oil has collected, the drops will be seen to be covered with the galena. If we imagine the centres of these drops to be filled with air instead of oil, we have conditions which might easily hold in an actual flotation machine.

On the whole, Mr. Durell's hypothesis does not seem to conform with actual flotation practice. There are other theories that explain flotation in better conformity with known scientific facts. T. J. Hoover, for instance, in his book 'Concentrating Ores by Flotation,' presents a consistent theory, and J. M. Callow presented a paper to the Utah Section of the American Institute of Mining Engineers in which were set out some theories based on experimental work done at the Mellen Institute and at the local station of the U. S. Bureau of Mines. This paper will undoubtedly be published soon in the transactions of the Institute.

JAMES A. BLOCK.

Salt Lake City, October 6.

Office Etiquette for Busy Men

The Editor:

Sir—The protest by Mr. Worden in the PRESS of October 23 on this subject should appeal to a wide circle of readers. Relative to the discourtesies inflicted on their business callers by pompous officials, a friend of mine (a chief engineer for a large mining company) used to remark that the more petty the official the more disagreeable he was liable to make himself, while the man of real authority is apt to be a considerate and gracious personality. I think it is often the case that a pretentious little office-man, holding a 10-cent job for a ramified corporation, loves to exhibit his fussiness and suspicion, but that a really big man, who does things worth mentioning, may seem even too much inclined to trust everybody. I sincerely believe, however, that courtesy in business is spreading rapidly. When the big corporations were first promoted the habit of curt unpleasantness obtained, in a belief, apparently, that all great men are gruff and impolite. Nowadays, the visitor at an important New York office (formerly the much-heralded abode of 'get-there' abruptness) is likely to be astonished at the quiet civility and considerate discernment. Occasional anachronisms remain, of course, and a caller sometimes finds himself cooling his heels under the suspicious surveillance of a commissionaire, but such cases are mostly, as my friend said, the pitiful attempt of a petty nobody to assume an air of consequence.

Berkeley, October 26. P. B. M.

Mining School for Employees

The Cleveland-Cliffs Iron Company, which operates about a dozen iron mines in Michigan, has maintained a mining school for its employees for three years. The purpose of the school is to teach mining to a selected number of employees, picked on the basis of their ability by the superintendents and foremen. Very few of such Industrial Corporation Schools exist in the United States but there is a great number of them in Germany, where they are credited with having been largely instrumental in producing the remarkable industrial development of that country during the past 20 years. The instruction is by lectures, classes, and mimeographed or printed instruction-sheets. At first the employees did not take well to the idea, although a few welcomed it, especially those who had already attempted to help themselves through correspondence-schools. Gradually prejudice was broken down, especially after the company authorized the statement that, so far as possible, all new shift-bosses would be chosen from those attending the Mining School. At the first class there was an enrolment of 38 men, of whom 33 completed the course successfully. It is interesting to note that two shift-bosses have been picked from the men who attended the school. The work of a class is planned to cover 18 months; there are two classes per week, each of $1\frac{1}{2}$ hours, one of which is in the afternoon for men working on night-shift and the other is in the evening for men working day-shift. All class-work is done on the miners' own time; they receive no remuneration from the company for the time given. Personal friendship with the men and a capacity for patience are cultivated by the instructor, these being largely contributory to the success of such a school. Only English-speaking men are taken; of the first class, 13 were American-born, 12 were English-born, 4 Finnish-born, 2 Swedish-born, and 2 Italian-born. The following subjects and phases of mining are taught: arithmetic, drawing, geology, use of mine-maps and blue-prints, first-aid, time-keeping, ore-sampling, stoping-methods, business-correspondence, use of a compass, elevations, etc. To educate mechanics and electricians, the engineers in the mechanical and electrical departments of the company conduct separate evening classes, one per week; any employee engaged in these branches of work is privileged to attend.

Planning Mine-Equipment

By P. B. McDONALD

Since buying of mine-equipment is being discussed, it may be worth while to touch on some modern developments in that line. Coincident with the tendency toward concentration of plant and the working of low-grade ore-deposits in a big way has come the practice of having expensive fire-proof buildings, increasing repair-shop facilities, modernizing the boiler-plant, and improving equipment in such hitherto neglected details as oil-houses, concrete-foundations, and sanitation. The growing belief in well-constructed and labor-saving equipment, with attention paid to workmen's comfort, ventilation, light, safety, fire-proofing, and automatic devices, has tended to elaborate initial installation over a proved orebody, and to augment considerably all first-cost construction. Far-sighted companies have even preferred to build a permanent steel or concrete structure where the cost works out about the same as a series of equally serviceable wooden installations. They deem it more business-like and satisfactory. Thus the Cleveland-Cliffs Iron Co. put up a mammoth and costly steel stockpile-trestle at its big Negaunee mine, rather than build and tear down a timber trestle at each shipping-season, though the final cost for the estimated life of the mine figured out about the same in either case.

The tendency at large mines is to construct mine-buildings of brick or concrete, and steel. Roofs may be of a variety of materials, concrete, special cement-plasters on light steel re-inforeings of chicken-wire or perforated metal, metal-sheetings, paper, tile, slate, and patent materials of various kinds. Steam-plants of several boilers are arranged to draw into one common stack, which may be of concrete, brick, or steel, and may be self-supporting or guyed. Light steel head-frames of two-post or four-post varieties, put up with fastenings in the joints like spring-cotters instead of rivets, so that the head-frame can be taken down and erected elsewhere, have become comparatively reasonable in price and more or less standardized in design. Steel and concrete oil-houses make a surprising saving in oil, being arranged with permanent steel barrels under the floor and equipped with pumps for filling cans. Concrete foundations under crushers, engines, head-frames, stacks, and 'location' dwellings are popular.

On account of the variety of special processes for mine-construction, a mining company in asking for bids on a building and accessories has a considerable range of choice. There is also an opportunity for the mine-engineer to do a lot of planning, estimating, and revising in drawing up specifications on which the constructing companies may bid.

For instance, some mining companies on the Michigan iron ranges have built machine-, carpenter-, and blacksmith-shops not in three buildings as formerly, but in one long building, separated by partitions to keep smoke or dust from circulating. This plan was adopted to save construction costs; it makes for convenience in taking work from one shop to another, especially in winter, a narrow-gauge track for a push-car running through the shops. Many different ways can be devised for housing the same machinery and equipment, each with its advantages and disadvantages in convenience, space, windows, cost, and lay-out. Changing the shape of a building, spacing trusses and purlines differently or altering the style and angle of the roof, may give the same results at appreciable reductions in price. An engineer with a bent for analyzing different estimates, and with plenty of time for his computations, can save a company not only a large amount of money in first cost, but by anticipating operating economies and conveniences can accomplish enduring results in routine. It is pertinent to remark that permanent construction is difficult to alter after once completed; particularly is concrete a stubborn substance to drill, cut, or break.

One mining company in Michigan that planned an elaborate system of electrification of its pumping, hoisting, and air-compressing, at a dozen mines scattered over rather a wide territory, sent several members of its staff to Europe to inspect installations of the most modern and approved types. The results attained were most satisfactory. By damming a comparatively small stream (partly composed of mine-water pumped from its mines) and conveying the water several miles in wooden and steel pipe, a head of some hundreds of feet was obtained; the turbines, control, and equipment are of particularly elaborate order. In much the same way the Dome Mines Co., of Porcupine, previous to the building of its mill and development of its mine, sent two of its officials to inspect gold mines in the West and Alaska.

Several mines on the Michigan iron ranges have concrete-lined tunnels just below the surface of the ground from shops and change-house to the shaft. Thus, drill-steel, rock-drills, pumps, etc., can be brought from underground to the shops without inconveniencing operations around the top of the shaft. And the miners can pass to and from the change-house to the man-cage without going outdoors; this is especially convenient in winter, when at other mines crowds of miners in wet clothes have to wade in snow or wait for the cage in a storm. A narrow-gauge track with push-car supplements the tunnel to the shops.

A special building-material for walls, roofs, or floors, called 'Hy-rib,' made in Detroit, has proved popular on the iron ranges; it is a cement-plaster on a light, perforated, and roughened metal re-enforcing. Curved

roofs for a mine oil-house can be made handily with it, the re-enforcing first being fastened to the steel members of the walls. Sometimes, as for a change-house roof of rather flat design, concrete over a re-enforcing of old rails is used. For a roof sheltering machinery, such as hoists, compressors, or dynamos, some engineers claim that concrete roofs 'sweat' and drip water, tending to rust the machinery. The matter of a roof is more important than at first appears. Owing to the steel trusses and purlines, and to the increased area on account of arching, roofs are costly; therefore any way of saving roof-space is worth considering. Windows are also important details, and well repay careful planning. In climates where snow does not complicate roof-loads, roofs can be flatter, although in a windy district snow blows away practically as soon as it falls on a roof.

Electricity is playing an increased part in mine-operating. In the submarine iron mine of the Nova Scotia Steel & Coal Co., on Bell island, Newfoundland, electric underground 'steam-shovels' of an over-all height of 12 ft. above the rail and the ability to turn completely around in a radius of 25 ft., have given excellent satisfaction in the stopes. Electric hoists are, of course, now quite common; some of the cheaper, simpler ones suitable for small mines operate apparently much like a trolley-car. Hoists with the expensive motor-generator set, with fly-wheel that will run for hours after the electricity is shut off, will operate on a surprisingly small constant current with a flat load-curve. Electrically-driven air-compressors, both belted and direct-connected, are a proved success. The direct-connected Ingersoll-Rand compressor, with 'clearance-control' device for regulating current to meet the varying needs of air in the line, have been installed at a number of iron mines in Michigan. Electric plunger-pumps seem to be preferred in efficiency over the centrifugal style in large wet mines, but the multi-stage centrifugal pump with several relays for deep mines is a much-liked feature on account of its lower price, compactness, simplicity, and ability for handling muddy water.

The popularity of the Prescott steam pump for the very wet mines of the Mesabi range is conceded; they have the name of being economical on steam. For explorations, rough-and-ready work, pumping mud, sludge, or dirty water, the old reliable Cameron tappet-valve pumps in their various sizes, persist in spite of their extravagant use of steam; nearly every iron mine in Minnesota and Michigan keeps Cameron-pump valves, packing, and springs on hand, and has several Camerons around the job somewhere. Incidentally there is a particularly powerful centrifugal pump of Cameron manufacture now on the market.

Herring-bone gears (of the Wuest type) have attained some success for geared hoists at the bigger Lake Superior iron mines, being noiseless and easy-running to an unusual degree. I remember seeing an 'expert' come from the factory to re-adjust a set of herring-bone gears at a new plant. He made a measurement and then ordered the gears moved a certain small fraction of an inch closer together, after which they ran perfectly.

Geology of Tintic

*This district is in Utah, 65 miles due south of Salt Lake City. It has produced silver, lead, gold, and copper amounting to $143,398,119, up to January 1, 1914.

There are three types of ore deposits in the district:

1. The limestone-igneous contact deposits that are widely distributed, particularly northward, but these have no economic importance.

2. Deposits in igneous rocks. The ore deposits in the igneous rocks are confined to the southern half of the district, where they occur as veins, varying in width from a few inches to 10 ft., usually pinching with depth. The average width is about 2 ft. The ore in its unaltered state consists of silver-lead sulphide and sulph-arsenides, occurring in bands and lenses in a gangue of quartz and pyrite. Since the closing of the Swansea mines there has been no noteworthy production from deposits of this type.

3. Replacements in limestone. The orebodies of this type are confined to the northern half of the Tintic district, and include all the mines now productive. Like replacement deposits in general, those of Tintic are very irregular in form; if any one form of orebody can be said to be typical, it is that of an irregular sheet, pinching and swelling along the line of the beds, and feathering upward into chimneys or pipes. Where the ore-channel is crossed by faults or zones of fracture, there is usually an enlargement of the orebody along the line of intersection of the faulting and the bedding.

At the intersection of the ore-channel by a fault, it is not an uncommon occurrence to find that the line of mineralization turns from the plane to the beds and follows the fault for distances up to 100 ft. or more, before again taking the usual course along the beds. Occurrences of this kind probably also account for the occasional division of a single ore-channel into two or more in parallel. Other things being equal, the coarser-grained, softer, and less silicious limestone are more susceptible to mineralization than are the fine-grained more silicious and harder ones, while the associated shale, sandstone, slate, and quartzite are uniformly barren.

By reason of the folded and broken state of the limestone beds, the ground-water level is extremely low (about 4765 ft. above sea-level), in the sedimentary rocks. This puts it at depths beneath the surface of from 2300 ft. in the higher properties to 1500 ft. in those having shafts at relatively lower positions. This condition has led to nearly complete oxidation of the original sulphide ores, with some downward segregation of the ore-minerals, and some enrichment due to shrinkage in volume.

The occurrence of ore within the monzonite and in the limestone; the character of the mineralization, the progressive change in the mineral composition of the ore with increased distance from the monzonite—all point to this rock as the factor in the mineralization.

*Excerpt from a paper by Guy W. Crane to be presented at the New York meeting of the American Institute of Mining Engineers, February 1916.

The Determination of Mercury in Cyanide Solution and Precipitate

By W. J. SHARWOOD

The most direct and reliable methods for determining mercury in ores depend on the distillation of the metal from the dried material under examination, reducing it to the metallic state if necessary by means of quicklime or metallic iron; the condensed metal is best collected by means of a weighed piece of gold or silver foil.

Several convenient arrangements of apparatus have been devised for the direct assay of low-grade ores. One of the best of these was described by W. W. Whitton,[1] in which a flanged crucible or wide-mouthed retort, turned from a piece of mild steel, is used with a light cover of silver foil, cooled by a flat-bottomed brass dish of water, the whole system being connected by a clamp engaging a steel plate with a hole in which the crucible fits. The earlier method of Eschka[2] uses a porcelain crucible with a gold cover, hollowed to contain water for condensing mercury; similarly Chism[3] employs a porous annealing-cup covered by a flat piece of silver foil on which rests a metal dish of water. G. A. James[4] has described a somewhat more elaborate arrangement in which the silver lid of a nickel crucible is cooled by a copper box through which water circulates.

Similarly one can use a thin-spun iron crucible, best one of the type provided with a rim; or the hat-shaped nickel crucibles sold for determining carbon in steel. The crucible should be fitted into a hole in a steel plate, or in a sheet of 'transite' asbestos wood (not ordinary soft sheet-asbestos) which is stiff enough to allow of clamping the cover on, if necessary. A small flat 'tin' box, with the tin carefully sandpapered off the bottom, will answer for the cooling system.

In any case the material is mixed with clean iron-filing, or well-burned quicklime, or preferably with a mixture of both, covered with the same material, and heated for 15 to 20 minutes, the bottom of the crucible being maintained at a dull-red heat, while the gold or silver cover is kept cool by water, which may be allowed to boil throughout the assay, and must be replaced from time to time as it evaporates. It is then allowed to cool about two minutes, the foil is quickly removed, rinsed and dried if necessary, left a few minutes in a desiccator, and weighed. The difference between the original and final weights, to the nearest tenth-milligram, is due to mercury condensed. On heating nearly to redness for a minute the foil returns almost to its original weight.

Gold is preferable to silver for catching mercury, because a mere trace is visible on its surface and it absorbs a larger amount on a given area. A silver disk 2 inches in diameter will hold about 50 mg. of mercury without difficulty, and even 100 mg., and may weigh 2 to 4 grams. The iron filing should be fairly fine, preferably passing 50 or 60 mesh, but having the dust removed by sifting over a 100-mesh sieve. The material known as 'crushed steel emery' (50 mesh) is better than filing. In any case, grease should be removed by treating first with alcohol, then with ether or benzene, and drying thoroughly.

The amount of ore should, if possible, be adjusted to give from 20 to 50 mg. of mercury; usually between 0.5 and 5 gram may be taken. If it contains organic matter (asphaltum, etc.) or much free sulphur this should be removed by carbon disulphide or benzene, and the ore should be quite dry when put into the apparatus. Usually about 5 grams of iron or lime is sufficient to mix with the ore, and half as much to be used as a cover.

When a Bunsen or Meker gas-burner is not available, a large alcohol-lamp may be used, but a Dangler gasoline-burner is much better and is fully as satisfactory as gas. The same apparatus is available for the final collection of mercury from cyanide precipitate and solution.

In Cyanide Solutions. When found in working solutions the mercury is usually in very small proportions, expressible as a few parts per million and comparable in quantity with the gold present. In exceptional cases, as when treating old pan-tailing, or when concentrate is ground with mercury and strong cyanide solution, as at Cobalt, much larger amounts may be dissolved. The metal itself is slowly soluble, but mercuric oxide is readily dissolved by cyanide solution; mercurous salts are decomposed, half of the mercury dissolving and half being separated as metal. In the resulting solution it exists as double sodium or potassium mercuric cyanide ($Na_2Hg''Cy_4$ or $K_2Hg''Cy_4$). This does not respond to most of the ordinary tests for mercury, but is decomposed by soluble sulphides and by metallic zinc or aluminum. In precipitating gold and silver by the usual methods, therefore, nearly all the mercury is thrown down with the precious metals.

In ordinary cases, where the ordinary tests fail to precipitate mercury, its presence may be detected by precipitating a large sample of solution in the first place by metallic aluminum, or zinc-dust, as in the Dowsett test for gold, then acid-treating and examining the small

[1] *California Journal of Technology*, Vol. iv, p. 35; Sept. 1904.
[2] Furman's 'Manual of Practical Assaying.'
[3] Trans. A. I. M. E., Vol. xxviii, p. 444.
[4] *Eng. & Min. Jour.*, Vol. xc, p. 800; Oct. 22, 1910.
See also M. & S. P., Vol. xciii, p. 606; Nov. 17, 1906.

bulk of precipitate left. When using zinc, care must be taken to distinguish a sublimate of metallic zinc, cadmium, or lead compounds, from one due to mercury; aluminum is to be preferred as a precipitant. The following method has been found to yield most satisfactory results, qualitatively and quantitatively. One part per million can be readily detected and weighed, if 1000 cc. be taken as a sample.[5]

Measure 1000 cc. of solution into a 2500 cc. acid-bottle, give the contents a rotary motion and add half a gram of the finest aluminum powder. Shake the bottle violently for half a minute, then give it a rapid rotary motion and allow to stand for a half to one minute; by this means the solution continues moving most of the time. Repeat the violent shaking, etc., at least 6 times—a total of 5 to 10 minutes. Meanwhile prepare a porcelain Gooch crucible, covering the perforated bottom with a layer of fine asbestos, and connect with an empty 2500 cc. bottle attached to a good vacuum-pump. A brass Chapman or Richards filter-pump, giving a vacuum of about 20 inches, will usually handle several filtrations at once. Shake the solution again and pour it all through a large funnel into a 1000 cc. narrow-necked flask. Rinse the bottle twice with a little water and catch the washings in a small beaker. Pour the washings into the flask until nearly full, and pour the remainder upon the Gooch filter. Invert the flask over the filter with the mouth at least half an inch below the rim, clamp it in that position, and then allow the liquid to filter, using a good vacuum. It may require two or three hours to pass through. Remove the empty flask, rinse any adhering particles into a beaker, and transfer to the filter. Wash once with distilled water. When sucked dry, wash once with alcohol, using a pipette to rinse down the sides of the crucible; when drained, wash twice with a little ether to remove any oil, etc. Remove the crucible and heat gently till thoroughly dry; transfer the asbestos filter-pad and contents to a Whitton or similar mercury apparatus with a weighed gold foil, and proceed exactly as with ores.

Using 1000 cc. of solution, every milligram found corresponds to one part per million, and half a milligram of mercury is easily visible on gold foil. If the solution is very low in alkali and in cyanide a gram of caustic soda may be added; much more is undesirable. In case of doubt there is no harm done by using additional aluminum powder.

Zinc-dust is not a satisfactory substitute for aluminum; the excess of zinc must be removed by hydrochloric acid, and the cadmium it contains also interferes.

In Cyanide Precipitate. The precipitate, obtained by treatment of cyanide solution with zinc-dust or shaving, may contain mercury in the metallic state or as sulphide. The latter appears to be produced largely by the action of nascent hydrogen upon thiocyanates in the solution, during the reaction of the zinc with alkaline hydroxide, etc., in presence of mercury compounds, the thiocyanate being formed by the action of cyanide upon thiosulphate (CaS_2O_3 etc.), which in turn results from the action of hydroxides upon sulphides in the ore treated. Alkaline sulphides as a rule occur only transitorily in well-regulated cyanide solutions. The mercury in cyanide solutions is obtained from oxidized or finely divided mercury in the ore or tailing, the metal being slowly attacked and the oxide readily soluble. Metallic mercury in precipitate probably exists mainly as amalgam, in combination with gold or silver, or with unaltered metallic zinc. Sulphuric acid refining leaves both mercuric sulphide and the metal in the residue.

The best rapid qualitative test for mercury is to thoroughly dry a portion of precipitate and heat in a hard-glass tube, closed at one end, to strong redness. It is rendered more delicate by first extracting metallic zinc with warm dilute hydrochloric acid, washing thoroughly and drying; and by mixing with clean iron-filing and well-burned quicklime to decompose sulphide. The presence of gold and silver makes it more difficult to volatilize the mercury and necessitates heating more strongly. When distinct globules are not recognizable in the tube a small piece of gold foil, wrapped round a wire, should be rubbed inside the tube and examined. Care must be taken to distinguish between a sublimate of metallic mercury (forming distinct silvery globules) and one of cadmium, which is sometimes obtained from precipitate, and which comes from certain zinc-dusts, both domestic and foreign, from cadmiferous zinc ores. Cadmium in zinc-dust tends to concentrate in the resulting precipitate, and still further when the precipitate is acid-treated in the refining process.

In using the Whitton or similar apparatus for collecting mercury upon silver foil, the quantity of material taken for analysis should not contain over 0.10 gm. of mercury, and preferably 0.025 to 0.050 gm. From 1 to 2 gm. of precipitate is usually a safe amount, but some slime and concentrate precipitates have yielded over 10% mercury when raw, and considerably more after acid refining.

Place the weighed sample in a 150 cc. beaker with watch-glass cover, moisten, and add 10 or 15 cc. dilute hydrochloric acid. When action slackens add more acid, and finally heat gently until action ceases. All the lime, practically all the zinc and cadmium, and some copper and lead pass into solution. Dilute with warm water, stir, and allow to settle, and pass the clear liquid through an asbestos Gooch filter, using gentle suction. Heat the residue with a little more acid, dilute and filter as before; finally transfer all the residue to the filter and wash with hot water till all chlorides are removed. The filtrate may be used for the determination of calcium and zinc, and for cadmium if the residue has been thoroughly extracted with acid.

The residue contains all the mercury. As soon as it is sucked dry, wash once with about 10 cc. of alcohol (denatured may be used), using a pipette to rinse the sides of the Gooch crucible; then wash at least twice with

[5] A solution of mercuric chloride, as dilute as this, gives no appreciable color with hydrogen sulphide; with five parts per million a distinct brown coloration is obtained.

ether to remove grease, asphaltum, etc. These washings are discarded unless the organic matter extracted is to be determined by evaporation in a watch-glass. Disconnect the Gooch crucible and dry it in an oven or on a hot plate, avoiding a high temperature. Transfer the asbestos mat and residue to a suitable apparatus (Whitton or Eschka) with a weighed disk of silver or gold foil. Wipe out the Gooch with a wisp of dry asbestos and add to the residue in the retort. Add 5 gm. clean iron-filing or crushed steel and a little well-burned quicklime, and grind up with the residue, using a stout glass rod. Cover with 2 or 3 gm. of iron or lime. Clamp foil and cooler upon retort, heat for about 20 minutes, etc., exactly as with ores, and weigh the foil with condensed mercury.

Trade Openings in China

Gold is found in many parts of the province of Szechuan, China, but not always in paying quantities. According to a recent report from Chungking, the most important mine in Szechuan that has thus far been opened is located at a very mountainous place called Maha, which lies in the south-western corner of this province about fifty miles north-west of Ningyuanfu. The Government is very anxious to develop the Maha mine to the fullest possible extent, and is now undertaking a thorough reorganization. Two Chinese engineers, who studied mining engineering in Belgium, are employing a corps of trained assistants and about 1200 miners in the mining work at Maha. Both the Government at Pekin and the provincial authorities are giving them every encouragement, and there is reason to believe that this project will finally succeed. New mining machinery is needed to carry on this work to the best advantage. This opportunity is exceptional, inasmuch as the installation of a plant at Maha would doubtless result in further developments, since not only gold is found in the western part of this province, but antimony, iron, lead, silver, and copper also occur in considerable quantities, and will be mined eventually by up-to-date methods.

The great drawback to trade in the province of Mengtsu has been the lack of representatives to push the sale of their goods. The present time is exceptionally favorable for such an enterprise, as the two German firms which have hitherto supplied local buyers with machinery, etc., can now obtain no further supplies. There are inquiries for irrigation pumps, electric light machinery, flour and rice mills, material for the installation of waterworks in Yunnan-fu, locomotives and trucks for the Pishihehai Railway, and other items; but these can only be dealt with by a man on the spot who is prepared to make a contract for the goods delivered c.i.f. at Haiphong, possibly assist to some extent in their erection, and arrange the question of exchange.

According to a recent official report, the district of Tzeliuching, which lies in the south-central part of Szechuan, some fifty miles north of Suifu, is the most important industrial centre in West China. This is true not only as regards its present state of development, but also as regards its potentialities and possibilities. Tzeliuching at no distant date will place larger orders for foreign machinery than any other city in this part of China. Machines for drilling new wells, for pumping up the brine, and for evaporating the salt are of first importance. Simple hoisting engines to supplant the water-buffaloes should enjoy a large sale. Gas-stoves and burners and engines using gas for fuel could also be introduced. As the salt-wells are operated night and day, there is an excellent opportunity for the sale of electric-lighting plants. Telephone-apparatus is also in demand, and mine pumps and machinery are needed in the coal-fields.

Writing on the resources of the Kaihsien district, the American Consul at Chungking, Szechuan province, says that while there is not much chance of introducing textile-machinery at the present time, if factories are started and the industry develops to any extent, there ought to be a market for cheap looms of simple construction. Mining machinery might even now be sold to advantage, both for coal and iron, and a modern smelter might be established very profitably at Ma-chia-kou or Wen-tang-ching. With the cheap labor and the extensive deposits of iron and coal, there is no reason why the Kaihsien district should not become in the course of time an important manufacturing and industrial centre.

He also points out that, as the district about Chengtu develops, there will be an increasing demand for foreign machinery. Mining machinery is needed in the development of the region west of Kwanhsien, where lead, coal, silver, and copper deposits are said to be extensive. There is also a demand for machinery for the scientific refining of salt and sugar, and for the manufacture of paper, shoes, soap, candles, and many other articles. Modern sawmill machinery will eventually be introduced. Machinery for silk and cotton weaving could be used to advantage; much of the Thibetan wool that comes from Tachienlu to Chengtu could be made into fabrics at the latter city, where labor is cheap and water-power available.—*Journal of the Royal Society of Arts.*

Malachite is used in America for cuff-buttons, scarf-pins, and other articles of jewelry. When a Russian visitor was shown a chain of malachite by its proud possessor he remarked: "We build houses of it in my country." This statement was an exaggeration, but malachite is actually used in Russia for tables, mantle-pieces, and for columns in churches. These furnishings are, of course, not of solid malachite but veneered. In the Mining Institute, at Petrograd, there is a block of the pure mineral weighing 3400 lb. and valued at $15,000. The largest mass yet reported was found in the Myednorydyansk mine in the Urals, in 1835, at a depth of 240 ft.; it weighed 328 tons.

The mints of the United States coined 7,825,250 pieces during September, valued at $2,462,880; also 600,000 pieces for the Philippines, and 1,780,000 for Cuba. This use of silver is beneficial to mining.

Mining in Utah

By L. O. HOWARD

Development proceeds steadily in the Cottonwood districts. In addition to the Cardiff, South Hecla, and Michigan-Utah mines, the Sells and the Maxfield apparently have good bodies of ore. An impetus has been given to leasing by the results obtained at the Michigan-Utah, and discoveries, that should lead to further shipments of ore, have been made by lessees on other properties. The month has been marked by the payment of the first dividend in several years by one of the Cottonwood mines. The Cardiff company distributed $125,000 on October 1, this being at the rate of 25 cents per share on a stock that less than a year ago was sold for one-quarter of this dividend. The amount of ore being developed and the favorable indications for the finding of more have caused different interests to investigate the transportation problem in Little Cottonwood canyon. One project involves a narrow-gauge cog-wheel railway connecting the mines at Alta with the railroad terminal at Wasatch. This enterprise is in the promotion stage only, but if brought to a successful issue it will undoubtedly facilitate the shipment of lower-grade ore. There has been some talk of a new aerial tramway, but as yet little progress has been made toward a realization. It embraces two alternate arrangements, either an 8½-mile tramway from Alta to Wasatch, or an extension of the railway to a point a short distance below Tanner's Flat, to connect there with an aerial tramway from Alta.

One difficulty with any system of transportation in the upper canyon is the ever-present danger from snow-slides in the early spring. The sides of the canyon are cut by numerous gulches, which are steep and generally free from vegetation. The tramway that is now in use has been disabled each spring. An attempt to overcome the difficulty was made by constructing concrete piers on which single steel columns were erected to carry the track-cables, the idea being to reduce the resistance to slides. These supports simply 'jack-knifed' and pulled down the line.

The PRESS has reported the fatal accident at the Albion adit, where one man lost his life through remaining in a gaseous atmosphere until the oxygen in his helmet was exhausted. An ingenious plan was devised to recover his body. Men armed with punches perforated the air-pipe at four-foot intervals and were able to proceed gradually to the face of the adit.

Inquiry for the rare or little-used metals has increased. Manganese, antimony, molybdenum, and tungsten are in most demand. Few of these inquiries have led to business, the chief reason being the widely divergent views of vendor and purchaser. Mines producing these metals have not been developed in the territory tributary to Salt Lake, simply because there was no market for them prior to the War; consequently prospects alone are available. The prospector demands a substantial sum for his property with an immediate payment down, his view of the situation being erroneous. On the other side the buyer is generally only willing to contract for the ore and objects to assuming any of the risk of the venture. Both are wrong. A middle course, involving the payment of money by the capitalist to develop the properties for the mutual benefit of both parties on a proper leasing basis would be a desirable solution. The market, as far as anyone can foresee, will collapse at the end of the War; therefore it is manifestly unfair to ask the prospector to assume all the risks of development. On the other hand, he is wrong in asking an exorbitant price for a prospect that may have only a temporary value.

A sure index to the condition of mining is the increasing number of orders for patent-survey that have been filed in the local office of the U. S. Surveyor-General. I have tabulated these on the basis of the number of lode-claims for which orders have been issued in 1913, in 1914, and the first nine months of 1915. It appears that in the nine months of this year the number of claims ordered surveyed for patent exceeds the sum of those in the two years preceding. Whereas in 1913 one-third of the claims were in districts that I have called 'miscellaneous,' where it is likely the ground had been held for years, being finally patented to avoid assessment work during uncertain times, the four active districts of Bingham, Park City, Beaver County, and Cottonwood account for about one-half the number in 1915, while the remaining one-half are mostly carnotite claims in Emery and San Juan counties. Each of the four districts has made a gain, that in the Cottonwood being of special interest.

The large number of carnotite claims in the list for this year will doubtless cause surprise, but the work has been completed at most of them. The desire to patent is based both on the necessity for being in a secure position in the face of any legislation that may be attempted with a view to withdrawal, and the impracticability of doing extensive assessment-work on claims where any quantity of shipping ore is exposed, because of the lack of a market. Carnotite claims are developed in a manner peculiar to this particular type of deposit. Nowhere is the slogan "Follow the ore" more imperative. Nearly 100% of the orebody is extracted by development. The most economical results are obtained by employing a force so organized that the inevitable dead-work will be in a sufficiently low proportion to the total development. Economy is imperative when, as in this case, the cost of the ore f.o.b. cars is at least $55 per ton. These factors have influenced owners of good claims to seek patents.

Usually Utah has risen to the occasion when development of new minerals was demanded. At the time when

the growth of Salt Lake City called for modern buildings, supplies of granite, marble, onyx, and travertine were developed immediately. When radium was sought, Utah responded with large areas of carnotite ore. When the War caused a crisis in the fertilizer industry, the first commercial exploitation of potash was undertaken in this State. All of the rare hydrocarbons, such as gilsonite, elaterite, and ozokerite, have been found and produced locally. Oil alone is unrepresented. Yet a reserve may be available in the widely distributed oil-shales of eastern Utah, to be developed in time. Excellent iron-ore deposits await the favorable combination of circumstances that will afford the basis for an iron and steel industry in this region. A list of the economic resources of the state should not omit gypsum, the source of the plaster used for most of the buildings of the Exposition at San Francisco [Nevada also supplied a large quantity of gypsum for the Exposition.—EDITOR.]; the salt beds of the Great Salt Lake; and the natural asphaltic paving material of the Wasatch and Uinta mountains. Coal from Utah has furnished the coke that has been a big factor in making Salt Lake Valley a great smelting centre.

To those interested in flotation, I may mention the paper read in abstract by Mr. J. M. Callow at the recent meeting of the Utah Section of the A. I. M. E. It was replete with details of the equipment and operation of flotation-plants, including the cost of the different methods, capacities of different units on diverse ores, a discussion of the amount of oil required, and many interesting conclusions as to the 'why' of flotation. He suggested that electro-static conditions are an important factor. During a long series of tests it was observed that the easily-floated minerals were electro-positive and that the unfloated material was electro-negative. It was particularly interesting to learn that a recovery of over 90% was made on the lead carbonate in Tintic ores.

I have referred from time to time to new milling enterprises. They make an impressive showing, as indicating the increasing utilization of lower-grade ores. Seven new mills have been completed within the year, or are under construction; these have a combined capacity of 1700 tons per day. They are the Daly West, Big Four, and Broadwater at Park City, the Knight-Deru, and Utah Minerals Concentrating Co. in the Tintic district, the Cactus in Beaver county, and the Minerals Product Co. at Marysvale. Three mills have added, or are adding, flotation equipment. These are the Silver King Coalition, the Daly Judge at Park City, and the Utah-Apex at Bingham. At Midvale the U. S. Smelting Co. has doubled the capacity of its plant. Six of the ten utilize flotation, either alone or in connection with wet-concentrating equipment.

The production from Park City mines has been curtailed a little because of the low price for lead and silver, but is still over 230 tons of concentrate and first-class ore per day. Three of the companies paid dividends on October 1. The Silver King Consolidated distributed $63,750, the Silver King Coalition, $187,500, and the Daly Judge, $75,000. The Snake Creek adit has been driven nearly 12,700 ft.; the average progress with three shifts of miners is 15 ft. per day, for a cross-section 6½ by 8 ft., and a 3 by 4 ft. ditch. This adit has developed a large amount of water, the flow from the portal being about 8000 gal. per minute.

In the Tintic district lessees are active on the Chief Consolidated, Gemini, May Day, Bullion Beck, Eureka Hill, Colorado, Beck Tunnel, and Yankee Consolidated. The company operating the last-named mine is developing virgin ground in which ore rich in silver, gold, and lead is being found. Shipments from the district average about 400 tons per day, of which a good proportion is valuable on account of its content in zinc. Most of the Tintic mines are equipped with electric power; the mines using this, either in part or completely, are the Victoria, Selma, Gold Chain, Lower Mammoth, Tintic Central, Beck Tunnel, May Day, Yankee, Colorado, Iron Blossom, Gemini, Dragon, and Centennial-Eureka. The Chief Consolidated and Eagle & Blue Bell will soon be operated with electric power.

CARNOTITE MINING IN UTAH.

JOPLIN, MISSOURI, has been producing ores of zinc and lead for more than 50 years, aggregating nearly $300,000,000 in value. This year the production is expected to exceed $20,000,000, which is nearly equal to California's annual yield of gold.

Preferential Flotation

*A patent for the preferential treatment of mixed sulphides has been taken out by Leslie Bradford of Broken Hill. Heretofore a number of processes have been suggested for effecting separation of sulphides from zinc-lead ores by preferential flotation, that is, to obtain lead sulphide and zinc sulphide separately. Such processes, however, are dependent for their effectiveness on the advantage taken of some inherent characteristic of the sulphides by virtue of which they behave distinctively when submitted to treatment by flotation.

The new process consists of treating ores in a medium that wets the zinc sulphide, and which does not wet the lead sulphide or pyrite, and therefore leaves the last-named sulphides floatable while rendering the zinc sulphide temporarily immune to flotation. The lead sulphide or pyrite is thus obtained first as a float concentrate; thereafter the residues comprising gangue and zinc sulphide are treated for the separation of the zinc sulphide from the gangue.

This 'wetting' effect is procured by adding to an acid flotation solution a limited quantity of a substance that is decomposed by the said solution, and produces in this decomposition a reducing gas which is more or less soluble. Thio-sulphates, sulphites, and bi-sulphites are notably so decomposed in a solution of sulphuric acid with the production of such a gas (sulphur dioxide). With practically equal result, sulphur dioxide may be introduced directly into the solution, either as gas brought into it in a current, or added in solution. A similar result is obtained by means of another reducing gas, sulphuretted hydrogen, which may be introduced into the solution in the same way, or may be produced in it by adding sulphides or polysulphides that the solution is capable of decomposing.

In practice, a limited quantity of such a reducing agent is introduced into the flotation solution, prior to treatment of the ore therein with the object of procuring this zinc-wetting effect. The reducing agents are those belonging to the first group, namely, thio-sulphates, sulphites, and bi-sulphites, Mr. Bradford having found them more effective than those belonging to the second group. In the patent specifications certain systematic tests for determining the suitableness and effectiveness of reducing agents for the process are given. In the actual application of the process to a Broken Hill mixed sulphide, containing zinc and lead sulphides, the flotation operation is conducted in a plant of the type described in two previous Commonwealth patents, using the flotation-boxes set in series, and treating ore at the rate of 25 tons per hour. No serious difficulty is experienced in proportioning the sodium thio-sulphate used (the blende wetting agents) so as to ensure the rapid floating of the galena substantially pure, or as a high-grade concentrate rich in silver, and to leave the residue in a condition suitable for further flotation treatment for the recovery of the zinc sulphide.

*Abstract from *Australian Mining Standard*, July 22, 1915.

The treatment is preferably conducted according to the 'froth'-flotation principle. The procuring of the effect aimed at is dependent upon the presence of a frothing agent in the flotation medium, only when a reducing gas is introduced into the medium. It is not dependent on the presence of a frothing agent in the flotation medium when a reducing gas is generated in the flotation medium by a reaction of a substance introduced into it. In some cases it is found that enhanced results are obtained by digesting the ore with sulphuric acid and the reducing agent in a thick pulp, prior to subjecting the same to a flotation operation.

Foreign Trade

The following extract is a translation from an article in the *Deutsche Levant Zeitung*:

"America is beginning to break away from her old-time export methods and is preparing new openings in Russia. Hitherto Russo-American business broke on the credit question. The Americans usually demanded cash payment before export, while American banks denied them every aid in this direction. Now, however, they are not going to let slip the opportunity to supplant German trade, and the National City Bank of New York, according to a Russian paper, has extended the Russian-Asiatic Bank a large credit to cover Russian purchases."

This is of deep interest to several branches of the American mining industry, not only to mining-machinery manufacturers of all sorts, but to producers of copper, zinc, and iron. The immense export trade of Germany was built up through the careful co-operation of manufacturers, banks, and shipping interests, seconded by aggressive salesmanship of men who could speak the language of the country to which they were sent. The German banks were always ready to take the manufacturer's or merchant's paper, with the foreign bank behind the foreign merchant, even if it were a twelve-months' credit. Both made money, the discount at Buenos Aires being 8% when it was 6% at Hamburg. Instead of treating such a man as a person of whom to be suspicious, the banks and the Government were anxious to hear his views as to the preparation of commercial treaties. In another particular American manufacturers are deficient compared with their European competitors. They fail to observe specifications as to orders and packing, treating many of them as absurd, and substituting what they think the foreigner ought to want, instead of what he wants and orders. The United States government is changing to some extent from a distrustful attitude toward foreign business to one more helpful. Reports of U. S. consuls in foreign countries, as to trade opportunities, are being made available for prompt and convenient distribution among business-men.

Peru is likely to become an important producer of rare metals. Antimony, molybdenum, vanadium, tungsten, and bismuth are found there, and some exploration and development of the deposits has taken place.

Hammer-Drilling in Colorado

By E. G. SNEDAKER

The purpose of this article is to discuss a few novel applications of the hammer-type, air-feed, stoping-drill to the work usually done by means of heavier and more expensive drills of the piston or water-Leyner type. The worth of these has been practically demonstrated in the Isabella, Golden Cycle, and Granite mines of the Cripple Creek district of Colorado. These methods have been developed by the 'leaser' or lessee. The lessee often has little money with which to buy expensive equipment.

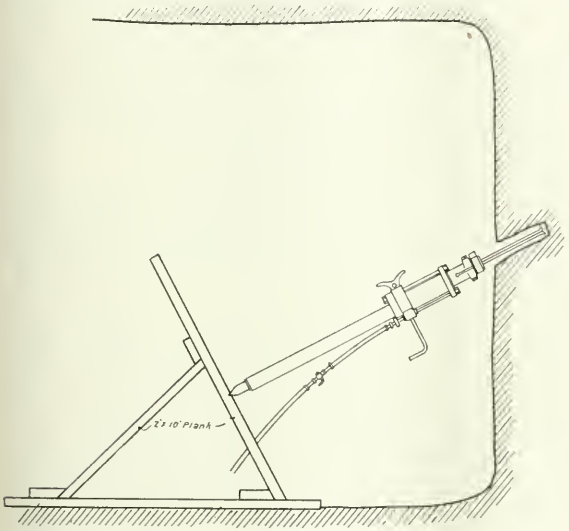


Fig. 1.

He must do his work as cheaply as possible, and employ every device known to save time, in order that his efficiency may be increased. This has raised the standard of all classes of mine work in the district and has led to the development of many devices for saving time, labor, and money. Driving with stoper-machines is one of the most ingenious means of accomplishing this purpose.

The lessee employs as few machines as possible. The major portion of his work is prospecting, by raises and drifts. In many cases he cannot afford a water-Leyner or piston-type machine because of the cost, and the impracticability of using these machines for stoping. The stoper can be used for driving as well as stoping, and is the machine that fits his need. The water-Leyner drill is the standard driving machine of the district, and subsequent comparisons will be made with it. The Waugh No. 16 is the stoper most extensively used in the district, and the drill employed in the driving operations to be discussed.

In the Cripple Creek district, for driving purposes, the water-Leyner stands alone. It presents many advantages. Passing air and water through the drill-steel is important, for the reason that it ejects the rock-cuttings from the hole during the process of drilling, so that the steel is cutting rock with every blow. Further, the fact that the dust is allayed at the same time, improving underground sanitary conditions is appreciated.

Another important feature of the water-Leyner is that it permits the use of an improved system of pointing holes, which when loaded and fired break more effectively than by other systems. The term 'Leyner cut,' applied to a round of

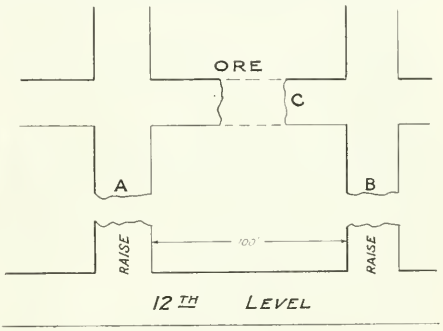


Fig. 2.

holes, has come into general use on account of the many upper or dry holes involved, which can be drilled to advantage only with this type of drill. From the fact that the drill-holes can be pointed exactly as they should be, without regard to angle, direction, or condition of the face of the working, and are not limited in position by the unwieldiness of the machine, as is the case with piston-drills, much less powder is required and the same breaking effect can be obtained with fewer holes of smaller diameter.

Waugh Stopers. It can be said that Cripple Creek is the home of the Waugh machine. It is probably true that more of them are in use in the district than all other machines of a similar type combined. For this reason, therefore, it is desirable to describe, briefly, the essential features of this drill.

The special feature of the sinking and driving drills, No. 8-D and 3-D, is the automatic tappet, which regulates the pressure in the air-feed cylinder, so that the drill will rotate easily. The duty of the air-feed cylinder is to keep the drill-steel against the bottom of the hole, where, by constant pressure, it extends as the hole is deepened. An air-feed cylinder with

sufficient area to keep the drill-steel against the bottom of the hole, when driving above the horizontal, would be found altogether too great on a down hole, when, in addition to the pressure in the air-feed cylinder, is added the weight of the machine and drill-steel.

The following is a brief explanation of the working of this automatic tappet, or regulator. There are two annular grooves, one inch apart, around the small end of the tappet. These grooves register with parts in the wall of the barrel that connects with the air-supply in the air-feed cylinder, and automatically regulate the pressure in the air-feed cylinder according to the hardness of the rock being drilled. This varying pressure is obtained by the shifting of the tappet, caused by the recoil of the piston-hammer. In drilling hard rock, this recoil is more accentuated than when drilling softer rock, and the position of the tappet is governed accordingly.

The model 16-V stoper, the machine used in the comparison, is a heavier and more powerful machine than the 6-V or 7-V, and is suited for drilling in all classes of hard ground. With it 1⅛-in., or even 1¼-in. steel may be used to advantage, where deep holes are required. However, inch steel will be found to stand up well in this machine, if the ground is not too hard.

The air-feed cylinder-nut, through which the air-feed piston works, is of the internal type, and is case-hardened. The air-feed piston is of cold-drawn steel tubing, fitted with double cup-leathers. The oil-reservoir of the automatic lubricating device is in the handle, the machine receiving while running a constant and adequate supply of oil. The diameter of the 16-V piston hammer is 2¾ inches.

Driving With Stopers. The column has often been used in connection with stoper-drills for driving, a special column being manufactured for this purpose. This, however, presents the disadvantages that the miner endeavors to avoid, namely, expense and time in setting up and changing the position of the drill. The methods discussed eliminate this time-consuming factor.

One method of applying stoper drills to driving is by means of a sprag. This sprag is placed 4 to 6 ft. from the face and about 3 ft. from the bottom. A loose 2 by 10-in. plank is allowed to rest against the sprag and the bottom, and is used as a base for the drill. This is the most primitive method in vogue and answers the purpose although it has several disadvantages. First, it is necessary to have a sprag of suitable length. The width of the drift necessarily changes from one shift to another, and a sprag that may answer the purpose one day may be too short or too long the next. Second, it is not always possible to place the sprag in the position desired, because of the unevenness of the walls.

Another method, which is a modification of the one just described, but better, is the simple A-frame (See Fig. 1). This is constructed of a 2-in. plank and is held in position by a sprag across the drift, as shown. The sprag has to be moved once or twice during a round, but this does not take much longer than changing the height of the arm on the column of a piston-machine. All the holes except the lifters are given an upward slope; they are put in nearly horizontal and cleaned by a blow-pipe connected with the air-supply. This method, while superior to the first, still possesses many disadvantages. First, it presents the same sprag difficulty as in the first case. Second, the A-frame is cumbersome, unwieldy, and liable to breakage.

Another example of the ingenuity displayed by lessees in keeping down operating and equipment costs may also be seen at the Granite mine. Two miners had a lease on one of the lower levels. Their work was entirely stoping and raising and their drill-equipment consisted of air-feed stoping-drills. They drove the raises *A* and *B* (Fig. 2); owing to heat and bad air, and also to assist in opening the stope, they decided to drive the drift *C* from *A* to *B*, thus giving an opportunity for ventilation. They could not, as is often the case, afford to purchase a driving-drill, but with the aid of a simple foot-plate, they found that they could use a stoping-drill to put in holes at all angles, from the vertical to the horizontal. This foot-plate (Fig. 3) was made of a sheet of ⅜-in. steel with ears turned down to act as spikes and hold the plate upon a plank. To this plate was riveted a piece of angle-iron bent to a U shape.

The drill used for this work was the standard Sullivan stoper. The rock was hard granite. The cutting speed was from 14 in. per minute in vertical holes to 8 in. per minute in horizontal holes. A blow-pipe was connected with the air-supply and used to clean the cuttings from the flat holes.

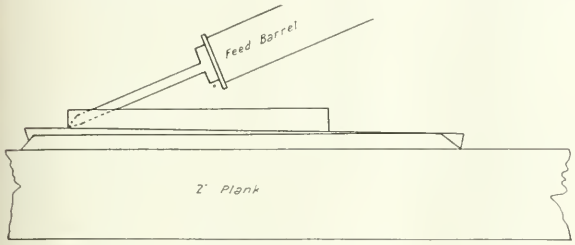
A more permanent support, giving a greater latitude of stretch, has been devised by Lee B. Kellum, master-mechanic at the Isabella mine. The first bar developed (Fig. 4) approximates closely in design the feed-arrangement of the Waugh stoper-drill. That is to say, the 'stinger' or feed-bar moves out of the barrel in the same manner as a piston. This piston is actuated by pressure from the air-line. The barrel is 2½ ft. long with a diameter of 2 in. The feed-bar is the ordinary one of a No. 16-V Waugh stoper, 2½ ft. long. This allows a stretch of from 2½ ft. to 5 ft. It is obvious, if a drift wider than 5 ft. is to be run, it is only necessary to make the barrel of the bar longer. This bar is satisfactory in every way, but the inventor has improved it by using standard pipe-fittings.

The method of 'setting up' is unique, especially when compared to the usual 'set up' of a drill using a column. It is necessary to shovel back for 4 or 5 ft., in order to provide an open space near the floor of the drift, in which to place the bar. Two small hitches are cut in the wall directly above each other and in such a position as to fit the claw of the bar. The water-tank is placed in a convenient position. The air-hoses are attached in their proper places, the main line to the three-way valve and thence to the drill, and an auxilliary line to the water-tank.

This is an ordinary galvanized-iron water tank of the Leyner type, about 4 ft. long and 1 ft. diam. It is fitted with two valves and a plug in the top. One valve to attach the air-line from the bar and the other valve

to attach the line to a blow-pipe, which is used to allay any dust that may become troublesome in drilling. The plug is to allow filling. The air, on being admitted to the tank, forces the water through the blow-pipe in a fine spray. This spray is directed at the hole and prevents dust from accumulating.

An ordinary closed iron chain, of inch links, is placed around the bar, as shown in the accompanying sketches (Fig. 4 and 5). When these preliminary operations have been completed and all connections tightened, the air is turned on by the valve at the drill and the tank closed. The air enters the bar, which expands against the sides of the drift. The claw fits into the hitches and prevents rotation, which tends to occur when actual drilling starts. The stinger or sharp end opposite the claw furnishes the other support against the opposite wall.



SIDE ELEVATION

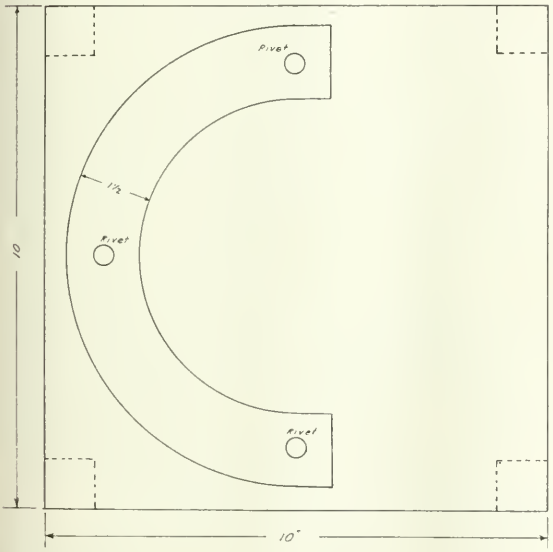


Fig. 3.

Up to this time all that is accomplished is to furnish a base for the stinger of the stoper-drill. As is well known, it is necessary to furnish such a base for this type of drill, whether false or natural. In stoping, the stinger rests on the filling of the stope, or on a platform built for such a purpose, and as the drill is working vertically, or nearly so, the drill needs no support. But in driving with the stoper a base must be supplied that will remain stationary and allow the drill to advance on the hole as in stoping, depending for horizontal support on the rigidity of the base and the depth of hole.

The air-line is now connected to the drill in the usual manner. The point of the stinger is placed in one of the links of the chain around the bar. This depends upon the distance required between the face of the drift and the butt of the drill and to what length the machine will extend. It is possible to have the bar close to the face and by placing the stinger in a suitable link, extend the drill 6 to 8 ft., the stinger being several feet behind the bar.

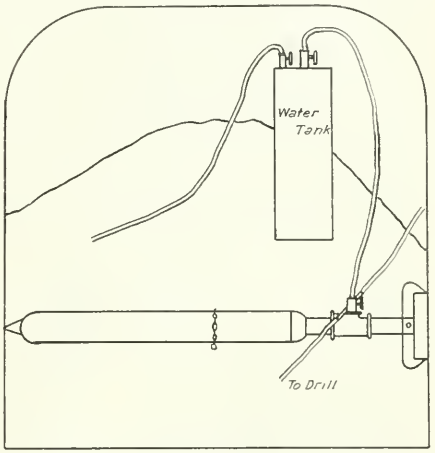


Fig. 4.

After the stinger has been placed in the proper link, the drill is pointed in the desired direction and the air turned on. From this point the operation is identical with the method used in stoping. Rotation is by hand.

It will be seen that if the bar is placed near the bottom of the drift it will permit the drilling of upper holes only. Therefore, as drilling progresses and the operator desires to drive a horizontal hole, he merely raises the bar the desired height and resumes drilling.

One should not lose sight of the fact that the drill is not supported in the middle. Its sole support depends upon its rigidity, the bar, and the depth of the hole.

Before taking up the number of holes drilled, and details of time and cost, it might be well to consider a few advantages and disadvantages of this method, in order that one may understand some of the differences in the time of changing steel, etc., which will follow.

It can be readily seen that as the holes become more nearly horizontal, the more precautions will be necessary. As this drill is rotated by hand and the steel is not fastened in the chuck, difficulties will arise when horizontal

or down holes are drilled. In drilling such holes the steel often must be removed by aid of a wrench. This changing of steel takes time and may become serious in broken ground.

Under conditions a little below the average, very fair figures were obtained with regard to changing steel and the length of time required for drilling holes. The air pressure was 60 lb., which is 30 lb. less than the average.

An upper hole, 4½ ft. deep, was drilled in 7½ min., using three changes of steel, showing a drilling speed of 7.2 in. per minute.

As this was an upper hole, no difficulty was encountered in removing the drill from the hole. On a down hole there is always the possibility of sticking and no fair figure can be given. The number of holes drilled will vary with the ground, but a fair figure is about 15 holes per round, breaking from 3½ to 4 feet.

It has been possible, by working in a drift and a crosscut to break as high as 9 ft. on one shift, the operator drilling a round in each breast with the same drill. To do this would require a steady air pressure and no break-downs.

Using contract labor and a Waugh No. 16 stoper the following driving and cross-cutting was done in a latite-phonolite or spongy volcanic tuff.

Month.	Footage.	Cost per foot.	Cost.
October	63	$2.00	$126.00
November	37	2.00	74.00
"	93	2.25	209.00
December	49	2.25	110.25
	242		$519.25
Average cost per foot		$2.14	

The above costs are remarkably low. The footage for October, 63 ft., was made by two men working 15 shifts; the machine-man being paid $4 per shift, and the shoveler $3 per shift. During the four months the two men worked 52 shifts and drove 242 ft., 117 ft. of which was drift and 125 ft. was cross-cut. The total cost per day was $9.98, which includes drilling, blasting, 'mucking,' tramming, and caging.

The following figures, obtained from the superintendent of the Golden Cycle mine, serve as a comparison with those given. A 2¼-in. water-Leyner drill was used. Contract labor was employed, and the figures also include powder, fuse and caps.

Following are the costs per foot of driving in the Golden Cycle mine, Colorado: $2.69, $2.77, $2.76, $2.72, $2.72; total, $13.66; average cost per foot, $2.73.

A comparison between the cost by the stoper and that by the Leyner shows an advantage in favor of the stoper.

It is apparent that this method of using stopers for driving saves first cost and up-keep.

The advantage of these drills in driving, as compared to the Leyner and similar types, lies in their light weight, ease of handling, saving of labor, cheapness, and ability to perform more work.

[The above description of ways and means employed in the Cripple Creek district are all the more interesting when it is remembered that it was at tunnel-driving in homogeneous granite in Colorado several years ago that the remarkable efficiency of the new-style drills and drilling methods first attracted attention. It was in the West that most of the modern drills and sharpeners were devised, not in some factory or experiment-station near New York, in spite of the fact that high-priced drill-experts ruminate over their little inventions there. The low costs of driving tabulated above indicate what men working for lessees can do, and are an agreeable revelation of the adaptability of the stoper-drill. The use of stoper-drills is somewhat of a local question; for instance, there are few of them in the Lake Superior copper region and their introduction in the Alabama iron-ore mines has been slow. On the other hand, in Colorado, on the Marquette iron range, and in many other districts, a tremendous number of stopers are in use.—Editor.]

Public Mineral Land. In the Report of the Commission on Industrial Relations, the Director of Research and Investigation, Basil M. Manley, suggests that the Commission recommend:

1. The enactment of appropriate State legislation providing that where communities develop, even upon privately owned land, the powers of the civil Government shall not be interfered with, nor shall the rights of access to the residence of any person be restricted, nor shall the rights of persons to come and go unmolested, to speak freely and to assemble peacefully, be interfered with or considered to stand upon a different basis from the rights of persons in other communities.

2. In the case of public lands containing timber or minerals, which are now or may hereafter come into the possession of the Federal government, it should be provided by statute that neither the lands nor the mineral rights should under any circumstances be sold, but should be used only upon lease for a limited term, such lease to contain as a part of the contract the conditions with regard to the rights of inhabitants as recited above and such lease to be forfeitable without recourse in case of the infraction of said conditions.

Platinum producers in the Urals, Russia, are now obliged to mortgage their product to the Ekaterinburg banks, because the French company that had a practical monopoly of platinum-buying and which was itself a large producer, was unable to continue its purchases. Moreover, the demand for platinum is slack. The Ekaterinburg price for small quantities of platinum was $28 to $29 per ounce. The amount of platinum mortgaged to the Ekaterinburg banks is estimated at 40,000 ounces. The output for 1915 will be much less than in former years.

The average death-rate of employees in the gold mines of the Rand for the last year was 3.22 per 1000. There were 564 persons killed underground, of which number 145 met death through explosives, and 110 through misfires.

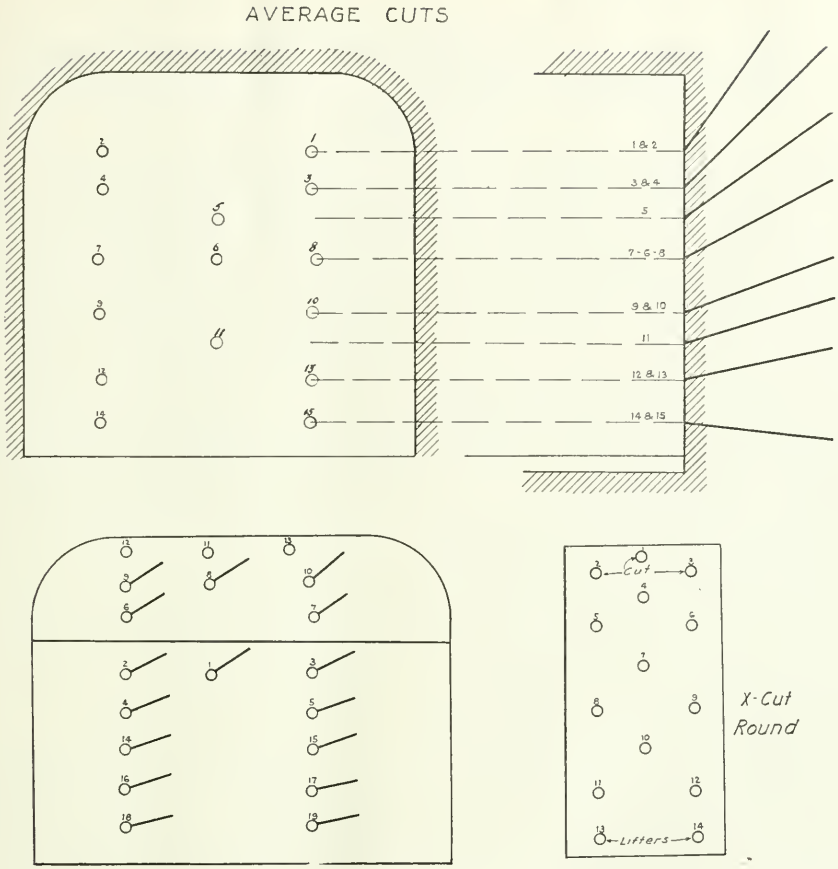


FIG. 6.

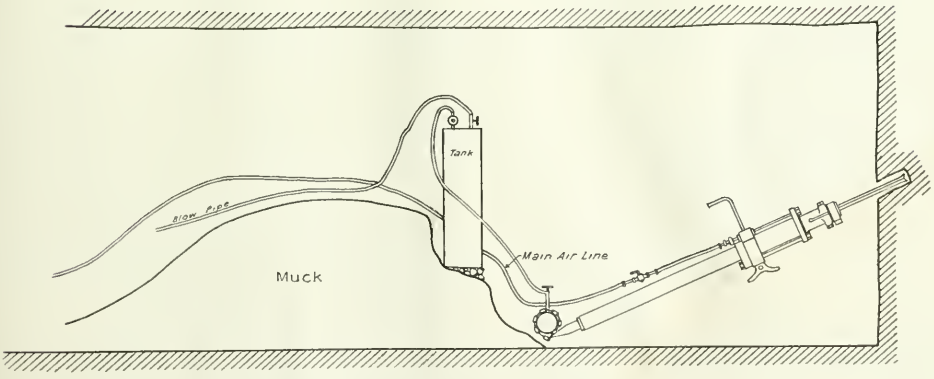


FIG. 5.

HAMMER-DRILLING IN COLORADO.

The Natural Taxation of Mineral Land

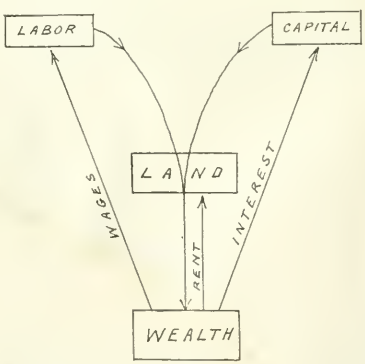
By R. B. BRINSMADE*

Introductory. Since my letter to the Press on mining law[1] was published in 1911, the ideas then expressed have begun to be embodied in American legislation. The enactment of the Alaska Coal-land Leasing Act and the passage of the Oil-land Leasing Bill in the Lower House, by the 63rd Congress, are encouraging signs of a national awakening as regards the legal needs of the mineral industry.

The continuance of the leasing system for mineral school-lands, as on the iron ranges of Minnesota and in the coalfields of several Western states, are signs that the individual States, too, are beginning to consider the interests of society as well as of first-comers, in their administration of natural resources.

By the adoption of the leasing system of Spanish America for all the remaining Federal mineral lands, the public interest can be henceforth conserved, but even this reform would not affect the vast area of mineral land already acquired by Federal patent or by the freehold surface titles of the Eastern states. The evils of land speculation and monopoly, which are now so prevalent in many mineral regions as to bar the independent prospector from making explorations and the small capitalist from entering mining, are not incurable but can easily and legally be remedied. A beginning was recently made by the adoption in Michigan of a new system of mining assessment[2]; but to be completely effective this reform must be supplemented by a more rational theory of taxation than the prevailing one.

Before presenting my practical proposals, I beg leave to explain some of the principles of political economy upon which they are based:



In the accompanying diagram, Labor, with the assistance of Capital, works on Land to produce Wealth, which is then distributed: Wages goes to Labor, Interest to Capital, and Rent to Land. This simple diagram can be fitted to any productive industry, no matter how complicated, care always being taken to use its seven terms in their exact economic technical sense, as follows:

Land signifies the earth and its attributes, or natural resources; and it includes all such material gifts of Nature as can be monopolized. The value of Land is calculated after deducting all improvements due to Labor and it includes five main classes: Agricultural, Forest, Townsite, Mineral, and Public-utility franchise. In the technical sense, Land is not Wealth but merely one of the essential factors in production.

Wealth signifies any labor-product or handiwork of man; it includes buildings, tools, machinery, improvements, commodities, etc.

Capital, when used popularly, often includes both Land and Wealth, but technically it is restricted to the latter when used productively.

Labor signifies any mental or manual effort of mankind that aids in producing wealth.

Wages, Interest, and Rent are the rewards allotted to Labor, Capital, and Land, respectively, from the Wealth output. In popular language, the total income of a business man is often called 'profit,' but a little consideration will suffice to separate it into its three economic portions: wages, interest, and rent. Popularly also Rent may include the hire of both buildings and land (technically called 'real estate') but true rent means the income from land alone.

Dual Nature of Property. Given the same quantity and quality of labor and capital, the wealth output will vary with the productivity of the land utilized. This difference in the productivity may be due to geologic causes, which influence the fertility of the soil or form ore deposits, or to location, as in the case of townsites or public-utility franchises. As the benefits arising from either geology or location are not due to the individual landlord, he should not be allowed to monopolize them except on condition that he return to society an adequate compensation. Modern legislators, however, have hardly begun to recognize this self-evident principle and the indiscriminate confusion of property in land with property in true wealth, which prevails in existing laws, is the cause of most industrial evils.

In each industry there exists 'marginal' land, that is, land whose product leaves no residuum or rent after wages and interest have been paid. This marginal land varies in quality with commercial activity, but it may be described as the leanest land that has to be worked to

*Consulting engineer, Puebla, Mexico.

1'Texas Mining Laws,' Mining and Scientific Press, April 15, 1911.

2'Appraisal of Mining Properties.' Report of Michigan Tax Board for 1911.

satisfy the current requirements of the market. I can now state Ricardo's Law of Rent: "The normal rent of any land is got by deducting the produce of marginal land from the produce of the land in question, the same labor and capital being applied in each case."

In popular speech, 'speculation' means taking a risk of gain or failure, even in ordinary trade, but in this article it signifies the holding of property out of use for the purpose of obtaining an enhanced price. It is evident that land lends itself easier to speculation than wealth because it is imperishable and, being fixed in quantity, tends to advance in price as population and business increase. Speculation in wealth, on the contrary, is only profitable where the whole floating supply can be cornered for the purpose of obtaining, temporarily, that unearned profit which uncontrolled private land-ownership, in growing countries, tends to give naturally and continually.

The term 'promoter' is not synonymous with 'speculator;' the former is a necessary factor in starting all new enterprises for the development of land; while the latter is purely an industrial parasite, the modern robber-baron, who with paper titles blocks every road to production.

With a given quantity of labor and capital in a country, it follows that the greatest output of wealth will be obtained by applying them to the most productive lands. If a part of the better lands are held idle by speculators, the forced resort of the corresponding labor and capital to inferior lands will result in a lessened output.

Holding superior land idle tends to decrease the productivity of labor by causing it to be applied to a poorer quality of marginal land than would be necessary were the whole area of superior land in production before recourse was had to an inferior quality. Therefore speculation in land will always reduce wages; and, if carried on extensively, will artificially reduce wages in a new and thinly-settled country to the level that they would only have reached, normally, after a dense population had arrived for settlement.

The rate of interest (independent of cost for insurance of capital) is fixed by the *extra* output obtained by applying capital to marginal land. Hence every decrease in the quality of marginal land, produced by the holding idle of superior land, means a decreased advantage from the use of machinery, and consequently a less hire or interest for it.

Although speculation decreases the output of a country, the net yield or rent from any given tract of superior land is increased, since there are less wages and interest to be deducted from the gross product. The market-value of all superior land (which is simply the capitalization of its net yield, if developed) is correspondingly increased by the rise in rent caused by speculation.

Though supply and demand may name the temporary price of a commodity, its average price is fixed by the cost of reproduction on marginal land[3]. Speculation, therefore, by artificially lowering the quality of available marginal land will increase prices and the cost of living.

Land Monopoly. Capital and labor are movable, capable of being reproduced and therefore essentially competitive in nature. Land is immovable, fixed in quantity; therefore its control implies exclusiveness and monopoly. Thus the land-owner has the ultimate control of production and is also the residual legatee of the wealth-output, after the claims of labor and capital have been paid.

As competition tends to cut both wages and interest down to the lowest living rate, the residual and monopolistic factor, or rent, tends to absorb the whole gain proceeding from improved methods of production.

From this fact, that landlords are able to demand the cream of the wealth-output, arises the condition that most of the world's capital gravitates to the possession of the great landlords. As these latter prefer to be called 'capitalists' rather than 'landlords,' many reformers have mistaken capital instead of land for the controlling factor in production. This mistake was promulgated by Carl Marx in 1873 in his first volume of 'Kapital' dealing only with manufacturing; but when it was corrected in 1893 by the publication of the posthumous third volume of 'Kapital' dealing with land, it was then too late to alter the economic program of European political socialism, which had then used Vol. I of 'Kapital' as a Bible for 20 years.

It is the popular impression that a large corporation or union of such, called a Trust, is necessarily a monopoly and therefore an industrial danger. This erroneous conception arises from the confusion of monopoly with bigness; the distinguishing feature of monopoly is not bigness but absolute control of the object. Land, as now owned in modern nations, is a monopoly only because the holder can keep it idle or abuse it, at the risk of little or no penalty; the exclusive individual possession of land is not a social damage if its proper use is assured.

In normal competitive conditions, rent is not a factor in fixing prices, since marginal land is rentless. But for certain commodities, such as diamonds and anthracite[4], where the fund from which they can be produced is so limited in quantity as to be easily cornered by one company, there ceases to be any rentless land at all. For with all diamantiferous land in control of the diamond monopoly, the price of diamonds is fixed at a point to secure the maximum annual profit; and this artificially fixed price is quite independent of the cost of reproduction in the marginal diamond mine and might often yield a rent for such a mine.

Ethics of Land-Ownership. A modern nation is organized on a purely territorial basis; it depends upon the social grouping or location of its inhabitants. The control of land is thus the foundation of civilized society. Under the feudal system of medieval Europe,

[3] 'Political Economy' by J. E. Symmes.

[4] 'King Coal' by L. L. Redding in *Everybody's Magazine*, 1912.

the proprietors of land and the civil governors were the same persons, and land rents and land taxes were synonomous terms.

In feudal England, the land-owners were the gentry or governing class; they not only gave their own time gratis to the State but supported from their rents the public services of defense and justice, while charity and education were sustained by the church estates. The introduction of freehold tenure and indirect taxation enabled the gentry gradually to shift the fiscal burden of government onto the unprivileged producing classes; but even now in England the landlords recognize some obligation to the State, for they fill with zeal many unpaid or underpaid public offices. The adoption, however in the United States of the English aristocratic system of private land-ownership along with political democracy (and officials paid from the taxation of wages and interest, rather than rent) was an anachronism whose evil effects are every day becoming more apparent.

From my citations of economic principles, it is clear that the existing anachronism can be fully corrected by restoring the original obligation of private landholding, that is, the payment of the whole cost of government from the only legal unearned incomes, those from rent. Not only would this change decrease the public burdens of both low-grade mines and working miners but it would paralyze land speculation and monopoly, which are more injurious to society than even the inequitable distribution of rent.

Practical Proposals. I now beg leave to offer a plan for the application to mineral land of the only equitable tax system, that on land-values, which is called the 'natural' system because of the curious fact that rent, and consequently a percentage tax on it, rises and falls with the necessary expenses of government, which vary directly with population and business activity. As rent is a residual factor, it has normally no effect on prices; and a tax on it can thus neither raise prices nor be shifted to the ultimate consumer.

As the plan involves direct taxation, it would be applied by State law except in the Territories. Its ideal is twofold: first, to tax the mineral industry only on its land-values; second, to encourage the largest development consistent with human safety and the full utilization of mineral deposits. The application of the plan will be discussed in four proposals:

I. Separation of surface from mineral rights.

II. Mineral areal tax.

III. Mineral output tax.

IV. Abolition of taxation of capital and labor.

Proposal I. Separation of Surface from Mineral Rights. This proposal requires a new statute for the separate classification of surface and mineral property in the official tax-lists. It would involve no change in ownership and would simply separate all present land-titles into two portions: one to all surface rights, and the other to all rights over the minerals specified in Proposal II. There would be no need for separating land-rights in existing deeds or records; and such separation would only be required for all sales post-dating the new statute.

A portion of the separation statute should follow Australian practice, by declaring mining a public use, and arrange a cheap, quick, and simple procedure for the acquirement, at its appraised value, of such surface areas as would be necessary for the extraction of minerals lying under separate surface ownership[5].

This proposal involves an areal tax on all the underground rights in the State, whether any mineral is supposed to exist under any given area or not. The areal-tax should be high enough to stimulate the development of minerals and to discourage speculation of either the hold-up or monopolistic type. But it should be low enough to allow active operators to profitably carry a reasonable mineral reserve for the future and to have no compulsion to exhaust their ground by wasteful methods.

The exact rate per acre to achieve these ideals would naturally vary with every individual deposit, but such refinement would be needless, and in practice it would suffice to classify all mineral deposits into two groups: the first would include all deposits in place, of gold, silver, lead, copper, zinc, tin, iron, and other metals; and the second would comprise the surface placers of gold, tin, and other metallic minerals, and the deposits in place of combustibles (coal, petroleum, gas, etc.) refractory clays, tripolite, marble, sulphur, phosphates, and salines.

As a general annual rate for the areal tax, I suggest $4 per acre for Group I and $2 per acre for Group II. These rates are slightly lower than the labor tax of $5 per acre now exacted from holders of Federal metallic claims, and slightly higher than those of Peru, which are $3 per acre for Group I and half as much for Group II.

These rates should be increased for specially rich lands, like the Mesabi iron range or the Scranton anthracite field, and decreased for unusually lean lands, as the Southern clay-ironstones and the Texas lignite districts.

In order to give present land-holders sufficient time for the exploration or sale of their mineral rights, the full areal rates should be reached only after a transition period of 10 years, increasing the tax meanwhile annually 10% of the final rate. The payment of Group I would conserve all rights to both groups, but the payment of Group II tax would protect the rights to that group alone.

The inauguration of the areal tax would result in a scramble among land-owners to either develop their own minerals or sell them. This scramble would not only speedily reduce the price of minerals in the ground but also for the consumers, since it would raise the quality of available marginal land and thus decrease the cost of production.

For mineral rights of no present commercial value,

[5]'Mining Laws of Australia and New Zealand,' by A. C. Veatch, U. S. G. S. Bulletin No. 505.

the land-owners would usually refuse to pay the areal tax and such rights, if no purchaser were found at the annual tax-sales, could be resumed by the State without expense. Such valueless rights would include both land of no geological probability and land of a sub-marginal quality. The resumed land of the latter class would be available for future development by the public-leasing system; and even now would act as a check on private land monopoly by being freely open to prospectors for leasing.

Not only could the Federal government resume large areas of commercially valueless mineral rights in the Territories by the areal tax, but it could at once recover vast areas of valuable underground rights in both States and Territories by adopting the suggestion of A. C. Veatch:

"If Congress should enact at this time that in every case, both in the past and future, where the purchaser of land from the Government made a non-mineral affidavit, that all minerals belong to the Government, it would leave each man with exactly what he swore he was getting and exactly what he paid for. Such an act would be eminently just. In individual cases it would be less severe than the attempt that is now being made in the Western states to recover to the Government, by lawsuits, mineral land acquired under the agricultural-land laws. In these cases the Government seeks not only the mineral values but the surface values as well. It endeavors to take from the patentee everything; it asserts that the patentee has been a perjurer and has defrauded the Government.

"Under the plan here suggested all such points of difference and all such charges vanish. The oath is regarded not as a perjured statement, but as an honest indication of intent and desire. The claimant's statement that he was acquiring land only for agricultural purposes is made binding on him. The charge of fraud likewise falls; the Government has under this solution not been defrauded; it has sold the agricultural values and received the usual price therefor. The patentee retains what he has bought; the Government what it did not sell. This is a solution of the matter of Western 'mineral-land frauds' which can but appeal to all men as entirely fair."

As the selling-value of agricultural and townsite lands can easily be ascertained, the American custom of assessing this value (or the capitalized rent) for taxation is preferable to the European method of assessing rent itself; because by the latter scheme any land held idle for speculation, and therefore yielding no rent, would pay no taxes.

But in the case of mineral lands no accurate valuation can be made except in the two special cases of surface deposits, and of coal, iron, and other bedded deposits, which can be economically explored by boring. For the sake therefore of uniformity and simplicity, I deem it advisable to assess mineral lands on their rents, rather than on their selling-values, and to offset the consequent encouragement of speculation by the areal tax.

The proposed output-tax, being a tax on rent alone, will not be levied on the gross but on the net output of mineral; and it will therefore correspond to the royalty now collected by private landlords from those mining operators who furnish everything for production except the land itself, as in many cases on the iron ranges of Lake Superior or in the zinc districts of Missouri and Wisconsin. The output-tax would be the same fraction of the 'true' royalty and the surface-land tax would be of the true rent of agricultural land. The tax would be paid entirely by the land-owner, except in those leased mines where the landlord's royalty is less than the true royalty; in which cases the benefited lessees would pay their proportionate share too.

The true royalty of any mineral deposit is the net profit remaining after interest and sinking fund on the cost of betterments (as well as operating and maintenance expenses) have been deducted from the gross earnings. It does not include any deductions for 'interest' or amortization on any sums that might have been paid to former owners for the minerals themselves. In other words, the true royalty is the unearned income (or land-rent of the Trinitarian diagram) and in order to make its calculation accurate it would be necessary for all mineral producers of any size or permanence to keep their accounts by a uniform system, prescribed by, and open to the inspection of, the State tax-commission.

Proposal IV. The Abolition of Taxation of Capital and Labor. As Fillebrown estimates that only 40% of the present total revenue (Federal, State, and local) is collected from land-values, it is evident that the first three proposals would not inaugurate the natural tax for mineral land unless accompanied by a shifting of the incidence of taxation. If all public revenue were raised from land-values, it would imply an increase in the existing direct-tax rates of 150%, and an absorption by the Government of 40 to 50% of the land-rent now going to private parties; but, as an offset, the latter would pay no more direct or indirect taxes on their capital or labor.

If the Federal tax system were left intact, the necessary increase in the direct-tax rate, to raise all State and local revenue from land alone, would be about 100%. But these increases would not affect all property uniformly, since land has been valued separately from improvements in only a few localities; and these re-valuations have shown that usually rich land is under-valued and lean land is over-valued under the old combination method.

A State's first step toward the natural system would be the exemption of chattels and real-estate improvements from taxation. The process of exemption should be distributed over several years (as is now being done at Pittsburg and at Scranton, Pennsylvania) so as not to disturb unnecessarily mortgage and other contracts based on speculative land-values.

The application of the natural system to Federal taxation would merely involve a return to the taxing scheme of the Confederation Articles of 1781, which required the collection of all Federal revenue from the State treasuries, each State paying a quota in proportion to its assessed land values.

General Effect. If the plan were immediately inaugurated the mineral producers would pay the Government no more taxes than at present and they would be relieved, both as producers and consumers, of the vast tribute now wrung from them by land speculators and

monopolists. Except for the nominal areal tax, there would be no further taxing of mines in the development stage or of producing mines that actually yield no net profit above operating costs and interest and amortization of betterments.

The plan thus would indirectly subsidize prospectors to perform the needed service of opening new mines, and public revenue would not suffer, for it would dip deeply into the huge net incomes of the bonanza mines, which are now greatly under-taxed.

The resumption by the State of low-grade mineral rights, through the areal tax, would throw a vast area open to prospectors. This resumption and the royalty-tax would also make more ethical the work of the State geologists, whose efforts now, though mostly paid for by taxes on capital and labor, conduce only to the financial benefit of private land-owners. Under the plan, State-aid might be rationally and justly offered to prospectors, as in Australasia, where rewards are paid for the discovery of new districts and public drilling-plants and testing-mills are maintained.

The general effect on mining of a movement toward the natural-tax system would be to increase both wages and interest; not only by throwing all taxes onto rent but by increasing the gross output, owing to the higher grade of marginal land available, due to the release of big speculative holdings now idle. The only class that would feel the change would be hold-up speculators, whether poor or rich; the poor gamblers would have to go back to honest work while their rich counterparts would be henceforth forced to employ their talents and money in production, as their tribute-levying on the activity of others would be no longer profitable.

Answers to Objections. To forestall any objections to the plan on the grounds of radicalism, injustice, or impracticability, I beg leave to remark as follows:

While pleading guilty to radicalism, I wish to inquire if scientific reform can have other than a radical (root) foundation? It is just here that lawyers and engineers differ in method of thought; most of the former look only at the past, and, being afraid of first principles, they can only construct patchworks, while the latter must either understand the laws of Nature or ingloriously fail.

Our existing land and taxation laws have descended to us from an aristocratic past, but this fact is disregarded by most of our legislators, either from selfishness, venality, or from an ignorance of history and political economy. Scientific economic reforms must be preceded by an improvement in the legislative personnel and this can best be attained by adopting small unicameral legislatures and proportional representation; the former will enable the payment of attractive salaries and the latter will permit both intellectual independence and a public career, now almost incompatible[6]. The change from traditional to scientific methods in many law-schools is a hopeful sign for future legislative progress. The plan may interfere with vested wrongs, but will it insure any vested rights? Conservatives have opposed, on ethical grounds, every previous attempt of mankind to free itself from venerable, but unjust and oppressive, institutions. If any reform be founded on natural law and social justice it should be adopted as an ideal, and put in practice as soon as expedient, irrespective of existing institutions, however hoary. Has ethics any higher ideal than "Industrial rewards should be proportional to services rendered to society," and can this ideal be attained otherwise than by the natural tax?

By private-land privilege and monopoly the producers can be as completely enslaved, economically, to the idlers as by chattel slavery[7]; and even engineers not infrequently are made to feel the power of vested wrong-owners over their freedom as citizens. Should not miners, the most potent of wealth producers, begin to devote more attention to the consideration of wealth distribution, which is chiefly a political problem?

Vested wrong can be justly abolished without direct compensation to present beneficiaries, but the change should be gradual enough not to unduly cause hardship to innocent persons. Thus chattel slavery was abolished in Brazil by gradual uncompensated emancipation; a juster method for taxpayers than the purchase scheme of the British colonies, and a fairer plan for slaveholders than the war-measure emancipation of the United States.

The plan involves little not already in successful use elsewhere. In most countries under the Napoleonic code (Latin Europe and America[8]) and in much of Australasia, underground rights are separated from surface rights and are assessed an areal tax and an output-tax. Both Canada and the Transvaal share in the net profits of many private mines; while the resumption of Proposal II is less drastic than the existing laws of Tasmania and New South Wales, which permit the State to resume any undeveloped mineral land by compensating its owner for surface values alone.

[6]'Proportional Representation' by J. H. Humphreys.

Gold Output of Australia

For the first eight months of the current year the yield was as follows, in fine ounces:

State.	1915.	1914.	1913.
New South Wales	90,833	82,852	96,576
Queensland	171,467	157,280	178,167
*South Australia	4,000	4,000	5,500
*Tasmania	11,360	17,500	22,266
Victoria	215,763	285,069	290,576
Western Australia	804,256	813,221	857,335
Commonwealth total	1,297,679	1,359,922	1,450,420

*Approximate.

Gold output of the Rand in September was 776,000 oz. For the nine months of 1915 a large increase was made, and the current year should be equal to 1913, the largest on record.

[7]'The Menace of Privilege' by H. George, Jr.

[8]'Mexican Mining Laws,' Trans. A. I. M. E., Vol. 32; 'Colombia Mining Laws,' Trans. A. I. M. E., Vol. 28; also publications of Pan-American Bureau, Washington, D. C.

Concentrates

Readers of the Mining and Scientific Press are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Over 10% of the coal production of the United States is used for domestic purposes.

Owing to the curvature of the earth, a mountain 5717 ft. in height would be invisible at the distance of 100 miles viewed from the sea-shore.

Gasoline engines cannot safely be employed underground in mines, unless the exhaust gases can be conducted by pipes out of the mine.

Mirages are due to refraction and reflection from layers of air of different density, such as are often formed above a wide expanse of level country in warm weather.

A carelessly used ladder is a dangerous thing; it is stated that slipping ladders cause the death of 6000 and injury to 200,000 persons every year in the United States.

Fossils are considered an aid to coal prospectors. Certain fossils indicate the presence of high or low-grade coals. This is especially true in the Grand Mesa coal-bearing region of Colorado.

An ordinary gauge-glass, nearly filled with water, and plugged at each end with putty or some cementing material, will serve as a level when none other is available. The bubble can be made any length desired.

The stamp-sand or tailing from Michigan copper-mills of which there is such a tremendous amount in Torch and Portage lakes is utilized to advantage in the manufacture of concrete, asphalt, and roof-shingles. Steamers have been taking large cargoes of this sand to ports on the lower lakes.

Mass copper occurs in six levels in the Trimountain mine in Michigan, its thickness varying from paper to several feet. Extraction by chisels and other tools is slow and expensive, so cutting the copper by means of an acetylene torch is to be tried. The mass copper is sent direct to the smelter.

Slime settlement and filtration at the Leonesa mine, Nicaragua, was hindered by the clayey matter in the decomposed walls of the vein, but mechanical thickeners greatly helped the problem. The capacity of the stamps was increased by making the depth of the discharge of the mortar-boxes greater.

The Sons of Gwalia stamp-mill and cyanide-plant in Western Australia was recently altered at a cost of $154,000. It was estimated that the cost of $1.80 per ton and residue of 90c. per ton would be reduced to $1.56 and 66c. respectively. Actual results are $1.44 and 60c. per ton, equivalent, on an output of 13,500 tons of ore per month, to a saving of $106,400 per annum, which redeems the outlay in a trifle over 18 months.

Re-soiling dredged ground made good progress in Victoria, Australia, last year, according to the report of the Sludge Abatement Board just received. By means of advance stripping of soil, silt distributers depositing soil on dredge tailing, and a little leveling, considerable areas of land that grow fruit trees and grain are being reclaimed.

To determine whether wrought iron or steel pipe has been supplied to a mine the sulphuric acid test is reliable. Take a short piece of the pipe, and immerse it in one part H_2SO_4 and three of H_2O for six to eight hours; if the pitting shows a granular structure the material is steel, and if fibrous it is wrought iron. Hammer and chisel, cutting and thread, and emery wheel tests will show which metal the pipe is of in a few minutes.

Strength tests of structural timbers treated by commercial wood-preserving processes, showed the following conclusions, according to H. S. Betts and J. A. Newlin of the Forest Service: (1) Timber may be materially weakened by preservative processes. (2) Creosote in itself does not appear to weaken timber. (3) A preservative process which will seriously injure one timber may have little or no effect on the strength of another. (4) A comparison of the effect of a preservative process on the strength of different species should not be made, unless it is the common or best adapted process for all the species compared. (5) The same treatment given to a timber of a particular species may have a different effect upon different pieces of that species, depending upon the form of the timber used, its size, and its condition when treated.

Radium is extracted only from uranium minerals; it has been obtained from pitch-blende in Austria, Cornwall, and Colorado; from autunite found in Portugal; from carnotite associated with vanadium found in Colorado and Utah, from carnotite associated with ilmenite in South Australia and in Turkestan. The total quantity of radium hitherto produced in the world is about 1½ ounces of a value, at present, of about $5,000,000. The carnotite ores of Colorado yield over 75% of the production since the War; these ores are now marketable only when containing at least 1% of uranium oxide, that is containing one-twentieth of a grain of radium per ton. Carnotite contains both uranium and vanadium, and the Colorado deposits were developed originally for the vanadium content. To test any mineral for radio-activity, wrap a photographic plate in two thicknesses of black paper in the dark, place a key on the paper, and suspend a few ounces of the mineral over the key, the whole being contained in a box that admits no light. Another method of testing is to measure the rate of discharge of a home-made electroscope when the powdered mineral is introduced into it.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

OURAY, COLORADO

Base-Metal Recovery from Ouray Ores.—Camp Bird, Revenue, Mountain Top, Atlas, Wanakah, American Nettie, and National Belle.—Red Mountain District.

Mines like the Camp Bird afford an interesting problem, as regards loss of base-metal contents. In 1913 the concentrate shipped, 525 to 550 tons per month, assayed as follows: Au, 1.91 oz.; Ag, 19 oz.; Pb, 9.9%; Cu, 2.7%; and Zn, 14.5%. There is a custom plant of the Huff electrostatic type at Ouray that could save the zinc. It has never failed to do excellent work on concentrates (there is no mill in Ouray), but it is allowed to lie practically idle. It is stated that Joe Terry at the Sunnyside has been making $1000 per day out of the zinc-content of his ore for the last two to three months. He is putting in more Huff machines, but has made no move in flotation. Mears, Wilfley, and Slattery are doing well with their flotation plant at the Silver Lake mine. Hyde is still at Silverton, and is understood to be looking around for properties where his process might be installed to advantage.

E. H. Platt, formerly at the Revenue mine, and later superintendent of the St. John mine in the Montezuma district, Summit county, whose deal on the Revenue properties with the Tres Forcas Syndicate, London, almost fell through on account of the War, was expected in Ouray last week. It is said that they have made a second payment to A. E. Reynolds, who has agreed to wait till the end of the War for completion of purchase. They may do some work this winter, though rumor again says they contemplate leasing the Camp Bird mill.

There are many reports that the Camp Bird mine is to close this winter, but most of us do not believe it. Some of the men who are working machines underground speak well of the ore they are opening on the lower levels.

The Mountain Top, though in good ore when shut-down in July, had insufficient funds to construct a tram and mill, as well as develop, and G. H. Barnhart thought it best not to work at a high cost during the winter. It is rumored that the Liberty Bell people, who lost the Humboldt to the Smuggler-Union company, have been considering the purchase of the Mountain Top.

The condition of the Atlas is doubtful; but excellent work is being done with flotation there.

The Wanakah company (which has the Bright Diamond, Ironclad, Memphis group just north of Ouray), the American Nettie mill, and the pyrite smelter are in something of a mix-up. The Roberts family of Buffalo are now practically out of it. They had a splendid chance, but no managerial ability, and an excess of nepotism. It was too much of a family affair. They increased the capacity of the smelter at an absurd cost, and without regard to a continuous supply of ore. Barnhart is now general manager. He put through the original deal some six years ago, and then was forced out to make room for John T. Roberts, Jr. Beebe, water commissioner of Syracuse, New York, an engineer who made money at Cobalt, is now president and financier of the company. He is also interested in the Mountain Top. The American Nettie people (Wrisberg and Hartman of St. Louis) are developing their holdings by an adit below the lower quartzite, and are said to be in good ore.

Forester is going to make good on his lease on the National Belle at Red mountain, one of the old properties belonging to George Crawford group, and in the early days a good producer. There is not the slightest doubt that a small syndicate with a capital of $25,000 or $50,000 could go into that district, Red mountain, and make good by taking bonds and leases on half a dozen properties, and putting up a small custom mill with crusher, tube-mill, a couple of tables and flotation, but there was never much home money available for Colorado mines.

TORONTO, ONTARIO

Dome Mine.—Boston Creek Gold Prospects.—Nickel.—Fond du Lac.—Sesikinika.

At the Dome a station has been cut on the 700-ft. level, but little work is being done at this depth until improved haulage equipment has been installed on the 500 and 600-ft. levels. When this is finished, and the tank capacity in the mill increased, it is anticipated that the quantity treated can be increased to 45,000 tons per month. The output in September was 28,500 tons averaging $4.87 per ton.

There is great activity in development in the Boston Creek gold district, about 53 miles north of Cobalt. Prospectors have staked a number of claims there, and in the surrounding country, including most of the townships of Boston, Pacaud, and McElroy.——John Papapassimakes controls a large area, the most important claim being the Kenzie, where a large force has been at work all the season. The vein which has been stripped for 450 ft. has a 12-in. pay-streak, rich in free gold, the value increasing with depth. Two shafts are down 28 and 30 ft.——The Dominion Reduction Co. has optioned adjoining claims, has erected plant, and is sinking to 200 ft. on the ore-body 10 to 15 ft. wide, in some places low-grade.——The Sherwin-Williams Paint Co. owns a property, and is sinking two shafts on a promising 7-ft. vein.——Other mining men interested in the camp are James Hughes of Haileybury, C. Foster of the Tough-Oakes, S. Dobre, and C. S. Gzowski of Toronto, and T. Flynn. New discoveries are reported daily.

The Ontario Nickel Commission has completed its investigations in the Sudbury nickel district, where the companies interested afforded them every facility for familiarizing themselves with the conditions of the industry, including an inspection of their books and records. They will probably visit other mines in the north of Ontario, and will afterwards go to the United States for information concerning the refineries. They may also visit the island of New Caledonia, about four days from Sydney, New South Wales. It will be several months before any report can be made.

The British firm of Vickers & Maxim has sent an expedition into the Fond du Lac country, east of Lake Athabasca in northern Alberta, to investigate the nickel deposits understood to occur in that region. The party, consisting of 25 engineers and a large number of assistants and laborers, is in charge of H. V. Dardier, who went to England some time ago with specimens from Fond du Lac, in order to interest capitalists in the district. The expedition left Edmonton about three weeks ago, and as every effort was made to keep its object a secret, little was known of it until it was well on its way. The explorers will remain in the country for over two years, and took with them $50,000 of machinery and $10,000 of supplies. The total cost will be about $100,000.

The Bilsky syndicate of Montreal and New York capitalists have taken over the Smith-Labine gold claims at Sesikinika lake, comprising 120 acres, on which 18 veins carrying free gold have been discovered. A. M. Bilsky is in charge, and will employ 100 men at trenching.

PETROGRAD, RUSSIA

Final Statistics and Information on Gold and Platinum Dredging in Russia During 1913.—Possibilities of the Amur Gold Region, Siberia.

As usual the Permanent Consulting Board of Gold and Platinum Producers in Russia has collected data obtained in response to question-sheets sent out to the various gold-producing districts of the country, including Siberia, in which dredges are used. The present report, as can easily be understood, has been greatly delayed—it is for 1913—on account of the disturbance to the social organism caused by the War. The number of firms that have responded to the call for details is 16; these among them controlled 55 dredges: thus the report deals with three dredges more than did the report for 1912. But the report, as usual, is not complete. Full details are given for only 48 dredges—an increase of six compared with 1912, showing that the attentions of the Consulting Board are becoming more appreciated.

The companies that have supplied details are: The Bogoslovsk Gold Co., the Borovin Gold Co., the Verch-Isset Mining Co., the Zauralsk Mining Co., the Novo-Udylsk Gold Co., the Olekminsk Gold Co., the Putiloff Factories, A. A. Sovvinik successors, the Teptyarsk Gold Co., the Central Siberian, and Y. K. Yuskoff.

The total gold and platinum in 1913 for 48 dredges of which complete details were received was 110,348 oz. The general efficiency per dredge is expressed in the gold and platinum produced in the different years, 2298 oz. per dredge in the year 1913 against 2096 oz. in 1912; 2021 oz. in 1911; 1792 oz. in 1910; and 1811 oz. in 1909. But an increase per unit of dredge in gold and platinum production does not necessarily mean that the operations have been more efficiently conducted. The increase is largely due to the use of better and larger dredges. Yet the workmen naturally acquire more skill in operating, and probably also a more enthusiastic interest in the work. Thus though the production per dredge in 1913 was well in excess of that of 1912, the number of hours worked was appreciably less, being 3302 in 1913 against 3437 in 1912, which, of course, indicates a more efficient organization.

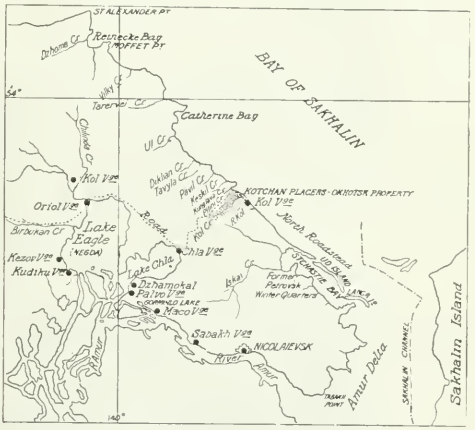
The quantity of gravel raised per dredge in 1913 was 247,687 cubic yards against 213,438 cu. yd. in 1912. The total production of gold and platinum by dredges in 1913 was larger in 1912 by 26,333 oz., an advance of 19.8%. This, in view of the fact that complaints are common respecting stagnation in the gold industry of the country, and the difficulty of stimulating to a larger production, shows that the Russian gold-producer, whether on his own initiative or under the pressure of Western European partners, is tending to employ large-scale methods of production that experience has proved worth-while, particularly as lack of success in the past has been ascribed to the petty methods employed.

Capacity of the dredges: four dredges produced up to 527 oz. of gold and platinum; two from 527 oz. to 790 oz.; three from 790 oz. to 1053 oz.; nine from 1053 oz. to 1317 oz.; six from 1580 oz. to 1843 oz.; seven from 1843 oz. to 2107 oz.; three from 2107 oz. to 2370 oz.; four from 2370 oz. to 2633 oz.; six from 2633 oz. to 2897 oz.; two from 2897 oz. to 3160 oz.; and two from 3160 oz. to 3423 oz. Eight dredges produced respectively quantities exceeding 3423 oz. rising to over 5260 oz. over 8952 oz. and over 1000 oz. for the three last in the series.

One point in which the report fails as compared with previous ones is the absence in the column headed 'Observations' of the names of the various dredge-makers. It is unfortunate that this was omitted, as it furnished a clue to the disposition of the gold-producers and enabled one to estimate the influence of the Russian dredge-makers, such as the Putiloff and the Neviansk companies, the former of which was known to be governed by outside influences, so much so as to discount the claim to Russian nationality.

Gold mining in the central far-eastern area, particularly in the Amur territory, is at present the subject of considerable interest. The old question has been raised of ways of communication in the districts where the gold deposits exist. In the Zei district, including seven mining areas—the Zei, Aldan, Timpton, Unyin, Sugdzhar, Gilyuisk, and Mogotsky—which embrace an area of 200,000 square versts (1 verst = $\frac{2}{3}$ mile) with an annual production of 400 poods (about 210,000 oz.) of gold, transport has always been difficult. Notwithstanding the energetic measures of the regional authorities and of the companies who joined them to have new roads made, and the old ones improved in the Zei district, only two roads are now available; these are only 156 miles long.

On account of the lack of roads in the gold-mining districts, a number of them have not been exploited properly. This refers more to the outlying districts; for example, in the areas of the rivers Aldan, Timpton, and Unyin, and others, there is a large number of properties containing rich gravel that are not being exploited because of the impossibility of delivering supplies, etc. Where there are wagon-roads, such as at Zei and Mogot, etc., it has been found profitable to exploit areas with



PART OF THE AMUR REGION, SIBERIA.

half the content of gold in the above-mentioned areas. Wages are 5 rubles ($2.50) per day with keep, while in the districts away from the roads the wage never exceeds $1.25.

The question of a part permission to engage Koreans and Chinese workmen at the mines, with less formality respecting passports, and their verification, is being discussed. Zeyu-Pristan, the centre of the Amur gold industry, was visited by the Priamur Governor-General Gondatti, and he decided to construct some wheel-roads in the gold-mining regions. For this purpose he was granted a credit of $1,500,000. Besides this, by his instructions, work on the main road between Zei and Tygda has been started, and the cost to be allowed is $132,500. Among other things, the Amur companies called the attention of the Governor-General to the fact that recently there has been observed an export of gold abroad without the certificate of the Russian authorities. On this account a special council of the companies was called and they decided to apply for the publication in legal form of the special prohibitory paragraphs in the mining law, in virtue of which workmen and employees on the mine have no right to keep gold, and are obliged to deliver it to the mine offices where it has to be entered in a special register.

The question has been raised concerning gold dredging along the rivers of the Amur basin. It is considered that dredging in this area has good possibilities. Peasants in the Priamur district have for years made good profits by washing the river sands.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

JUNEAU

It is probable that the Kensington mine will be re-opened next spring, and a 500-ton mill erected, according to D. C. Jackling of the Alaska Gastineau company.

At Treadwell the Mexican shaft is to be enlarged and deepened to five compartments and 400 ft. below the present bottom at 1700 ft. Cross-cuts will be driven at 1750 and 2100 ft. to a point under the shaft, connections to be made by raising. A new hoist and head-frame are part of the improvements.

Two miles south of the Treadwell properties is the Nevada Creek mine, in charge of M. S. Hudson. Twelve men are working, but more are to be engaged. A long adit has been driven. A 20-stamp mill is ready for ore. The company has been reorganized.

According to J. H. Mackenzie an 8000-ton mill has been designed for the Alaska-Juneau company. It will consist of four No. 9 gyratory-crushers, two jaw-crushers, twelve 6 by 8-ft. ball-mills twelve 7 by 10-ft. tube-mills, 48 roughing-tables, and 120 finishing tables. The plant will be in four units of 2000 tons each, the first of which is to be at work at the beginning of 1917. In the power-plant, to be on the beach, will be two 5000-kw. turbo-generators. Grading is to be commenced at once.

ARIZONA

COCHISE COUNTY

At the Sacramento shaft of the Copper Queen 30 ft. of concreting has been done, starting below the 1700-ft. level. Work was also commenced at 1200 ft. Hoisting of ore is not hindered.

A considerable amount of construction is under way at the Junction shaft of the Calumet & Arizona. A seventh hole is being drilled on the Washington and Angel claims, near the C. & A. hospital.

The Shattuck-Arizona company is mining 350 tons of 6% copper, 100 tons of gold-silver-copper, and 50 tons of lead ores per day.

The Bisbee Copper Mining & Development Co. is selling shares at Bisbee. Three drill-holes are to be put down in what is considered promising ground.

Developments in the Commonwealth Extension at Pearce are good. Some ore has been shipped.

The Mascot is sending copper ore to El Paso. The mine, in charge of J. W. Prout, is opening splendidly. In the Palace of Mines at the Exposition at San Francisco, is a large piece of ore from this mine.

GILA COUNTY

Asbestos has been found 12 miles from Globe, and claims have been located by Fay and Hubbard.

During September the Iron Cap mine produced 14 cars of ore assaying 12.65% copper and 11.7 oz. silver. The profit was $18,624.

At the Inspiration mill, when four Marcy mills are installed, the crushing departments of nine units will be complete. Three 100-ft. and one 200-ft. diameter Dorr thickeners are to be constructed at the bottom terrace of the mill-site. These are to make a thick residue prior to its going to Ellison canyon, and also to save the clear water for re-use. The mine is worked six days per week. Both main shafts are ready for operation, construction being complete.

GREENLEE COUNTY

The strike situation at Clifton last week was as follows:

A large number of pickets were placed at the mines and works on October 20, the strikers fearing that the companies were trying to bring in strike-breakers during the conferences.

A petition is being circulated for the recall of Governor Hunt.

On October 23 the conferences at El Paso ended without result, and nothing of moment has occurred since.

On the 25th the strikers gave R. S. Trejo, editor of *El Noticioso*, a Mexican paper at Morenci, 10 hours to leave the district, with threats of violence.

MOHAVE COUNTY

Seventy acres of the old Pioneer estate in the Oatman district has been acquired by Allan G. Burris, well known at Cripple Creek, Colorado. The main shaft is 400 ft. deep, and a 10-stamp mill is ready for crushing. Work has been started in charge of G. F. Moser. The company's name is the Oatman Pioneer Mines, Inc.

The United Eastern company is preparing to sink a three-compartment shaft, and grading for a 200-ton mill. An Allis-Chalmers hoist and Ingersoll-Rand compressor, drills, etc., have been ordered. On Silver creek a supply of 60,000 gal. of water per day has been developed. The supply will be augmented when the mine shaft is down 500 ft. At 465 ft. the vein is 350 ft. long, with wide shoots of high value. At 565 ft. the vein is also wide and valuable.

A dispute has arisen between the United Eastern and Tom Reed companies. The former connected its workings with the latter for ventilation and safety; the latter objected, and disobeyed the order of the State mine inspector, hence the trouble.

CALIFORNIA

Oil-production of the Kern River, McKittrick, Midway-Sunset, Lost Hills-Belridge, Coalinga, Lompoc-Santa Maria, Ventura County-Newhall, Los Angeles-Salt Lake, Whittier-Fullerton, and Summerland districts in September totaled 7,330,038 bbl., from 6109 wells. There were 140 wells drilling, and 31 completed during the month. The yield was a decrease of 3409 bbl. per day, compared with that of August. Shipments amounted to 7,778,807 bbl., also a decrease. Stocks decreased about 400,000 bbl. to 59,624,905 bbl.

According to James H. Tibbits, recently with the State Engineering Department, who was in Sacramento during the week on his return from a trip through Eldorado, Amador, and Calaveras counties, there is great activity in mining, and capital is offered freely for good properties.

CALAVERAS COUNTY

An old asbestos mine, six miles from Copperopolis, is being re-opened, and a plant for preparation of the product will be erected.

ELDORADO COUNTY

Gravel areas near Coloma, south fork of the American river, are being prospected with a Keystone drill. J. H. Mulloch of San Francisco is in control.

Around Placerville there is considerable mining activity at present.

NEVADA COUNTY

A 280-hp. water-power plant is being erected by the Artic Mining Co. in the Washington district. It will drive a compressor and other machinery.

The Black Bear company has ordered a duplex compressor of 1000-cu. ft. capacity, pipes, and a pump.

Near Moore's flat the Mohawk antimony mine is being opened by W. McLean of Nevada City and C. Scheunert of Sacramento.

Placer County

Near Colfax the old Big Oak mine is being unwatered by J. Toman, S. R. Break, Hubbel and others. On account of litigation it was idle for 21 years.

San Benito County

(Special Correspondence.)—A promising antimony prospect in the Lone Tree district is being developed by H. V. Underwood and L. H. Day. A good vein has been cut by an adit. Other mines in the same district that have been idle for years are being examined. Visitors are coming into the county to prospect, while capitalists are coming to buy, and it is hoped that many prospects will be developed in the near future. The county is rich in quicksilver, copper, and antimony, as well as many of the industrial materials.

Hollister, October 24.

Shasta County

The Red Top Mining Co. of Redding has bought the Black Cloud and Red Top properties for $13,000. A stamp-mill will be erected later.

deposit of chrome on Elk creek. It is approximately 800 ft. wide, on the surface, and has been traced for a length of 1200 feet.

Several hydraulic mines are being prepared for winter work. Among these are the Dave Huey, Sixes group, Classic, and Crumpton. The last is a practically virgin property containing 300 acres. George H. Crumpton is superintendent.

Happy Camp, October 18.

COLORADO

Clear Creek County

There is a shortage of teams at Georgetown to carry the ore mined by lessees at the Waldorf and other mines. The Terrible Dunderberg and Mendota mills are working full time.

Gilpin County

At Blackhawk a syndicate of local people has secured ground near Glacier lake, and will develop tungsten deposits. Rich shipments of gold-silver-copper ore continue from the Pittsburg mine on Russell gulch.——Lessees at the U. P. R. have cut good ore at 265 ft. depth.

DREDGE ON THE DERRY RANCH, COLORADO.

Sierra County

The Willoughby mine, 10 miles north and west of Sierra City, has been bonded by R. G. Moss of Berkeley. The property is being prepared for winter operations. An electric plant will be installed in the spring, also a compressor and two machine-drills. A steam hoist and pump are being installed at the Monitor mine near Downieville.

Siskiyou County

(Special Correspondence.)—Reeves Davis and associates of San Francisco are preparing for a busy season at the Van Brunt hydraulic mine. Approximately 2000 inches of water is available, and additional flumes are under construction. Henry C. Howard is superintendent.

San Francisco people are developing the Little Oak Hollow quartz mine on Elk creek, six miles from Happy Camp. A two-stamp mill has been erected, and it is proposed to soon have 10 stamps in operation. The ore is a free-milling quartz. M. Anderson is superintendent.

The Siskiyou Mining Co. is extending its 15-mile flume 1½ miles to work the gravel deposits on the Muck-a-Muck flats. The deposits have been thoroughly prospected and show good gold-content.

Schuler and Dolittle are developing a recently discovered

Lake County (Leadville)

(Special Correspondence.)—The new 6-cu. ft. dredge at Derry ranch, mention of which was made in the Press of August 14, is working an average of 21 hours per day, everything going smoothly. The first clean-up, for the week ended October 16, yielded nearly $7000. On account of the high cost of power, (1.65c. per kw.-hour) and labor, expenses are rather high, but the results are good. The boat, which was designed and equipped by the New York Engineering Co. of New York, cost about $125,000.

Leadville, October 19.

A new 300-hp. hoist was started last week at the Garbutt, which is producing 200 tons of ore daily. A mill is contemplated for this mine.

The Fortune mine is to send carbonate ore to the Zinc Oxide plant.

Rich gold ore is again being opened in the Connors lease of the Ibex.

Summit County

Molybdenite has been discovered near Fremont pass. From the Molybdenite mine, which has been leased to Leadville men, 1000 tons was recently treated at the Leadville District

mill, details of which should soon be made public. The ore contains up to 2% molybdenum.

TELLER COUNTY (CRIPPLE CREEK)

From the vein cut at 850 ft. in the Jerry Johnson, the Cripple Creek Deep Leasing Co. is shipping ore, the greatest depth ore has been mined at Ironclad hill. This company leases below a depth of 650 ft.; the ground above is leased by F. Caley, who is operating a 50-ton mill.

The Moose mine, on Raven hill, is being examined by T. Kavanaugh, well known at Cripple Creek. No work has been done since 1904. The property yielded some rich ore and paid dividends. The main shaft is down 1050 ft. on the incline.

Lessees at the C. K. & N. mine on Beacon hill are shipping at the rate of 550 tons per month. Development is encouraging. The output to date is $1,350,000.

IDAHO

BLAINE COUNTY

The Wilbert Mining Co., operating in the Dome district, has declared its first dividend of 1c. per share, equal to $10,000. Assessments amounting to $65,000 have been paid. The new 100-ton mill is producing high-grade lead-silver concentrate.

SHOSHONE COUNTY (COUER D'ALENE)

According to figures prepared by A. W. Belden and G. T. Edmiston of Wallace there are 5000 men working at mines and mills of this region. In the Wallace district the following are employed:

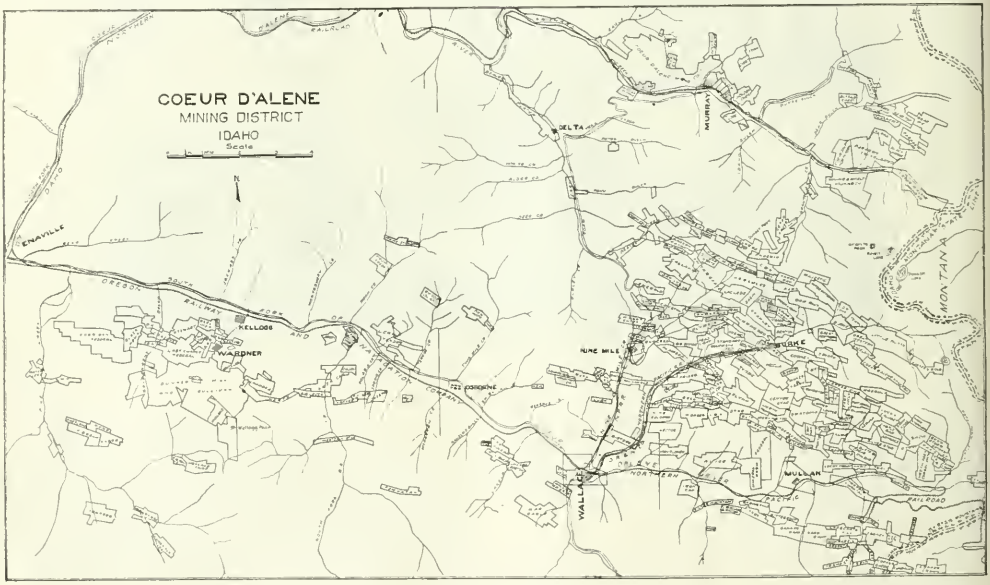
Bunker Hill and Sullivan, Wardner 800; Last Chance, Wardner 200; Caledonia, Wardner 40; Stewart, Wardner 250; Hercules, Burke 400; Standard, Mace 350; Hecla, Burke 250; Morning, Mullan 350; Hunter, Mullan 200; National Copper, Mullan 40; Interstate-Callahan, Nine Mile 200; Tamarack, Nine Mile 200; Success, Nine Mile 200; Marsh, Burke 80; and Frisco, Gem 150. In addition to these there are a large number of mines employing from 5 to 20 men each in the following districts: Pine Creek, Hypotheek, Highland Surprise, Little Pittsburg, Nabob, and Antimony. At Murray, 20 miles from Wallace, are the Paragon, Terrible Edith, Jack Waite, and Crystal. At Sunset the Silver Moon and the Tuscumbia. Big Creek, five miles from Wallace, has the Yankee Boy, G. Scott Anderson lease, Polaris, and Nellie. Placer Creek includes the Livingston Bros. holdings. Tributary to Burke, among the mines employing small crews and with ore opened are the Sonora, Oom Paul, Aetna, Imperial, and Veteran. In the vicinity of the Idaho-Montana summit, east of Mullan are the Silver Cable, Carbonate Hill, Reindeer Queen, and Snowshoe. The Saltese copper belt has the Richmond, St. Lawrence, Monitor, and Copper Age.

At the present rate of production the Interstate-Callahan mine has four years' supply of ore for the mill and shipments. The monthly output of concentrate is 6000 tons. In the suit of the company and the Callahan Mining Co., Judge Deitrich decided that further proceedings in the State courts be stopped.

September profits of the Stewart were between $65,000 and $70,000.

The Keystone Mines Corporation, operating on Blacktail mountain, in the Pend Orielle Lake region has 30 men on development, erected modern machinery, and blocked out a large quantity of copper-gold-silver and lead-silver ores, and is soon commencing shipments of these ores to Tacoma and East Helena respectively. Volney D. Williamson is in charge.

The Riblet Tramway Co. of Spokane has secured the contract to construct an aerial tram from the Hypotheek mine to the mill, which is to be built as soon as development warrants it.



CLAIM MAP OF THE COEUR D'ALENE, IDAHO.

The new aerial tram of the Interstate-Callahan is working well. At the Gertie the cross-cut is in 3720 ft., and the vein should be cut within 100 ft. This distance was driven in exactly a year, at a cost of $67,000.

At the Constitution zinc-lead mine on Pine creek, a compressor and hoist are to be installed; later on a mill of 150-ton capacity. A. G. Kerns of Wallace is president of the company.

The Cooney properties in the Burke district, have been bonded to M. W. Neary of Spokane for $150,000, $25,000 having been paid to Mark Cooney last week. Development will commence at once.

The Federal Mining & Smelting Co. is being sued by N. A. Butler for $10,000, for injuries received in its mine.

MICHIGAN

THE COPPER COUNTRY

The Calumet & Hecla re-grinding plant produced copper in September at the rate of 4,000,000 lb. per year, at a cost of 4c. per pound. The company is erecting a purifying plant adjacent to the electrolytic plant to improve the acid used in the latter.

The Franklin mill is operating four stamps, and the mine is producing from 800 to 1000 tons of ore daily. More machines are to be started on the conglomerate lode, the present quota being 34, and four on the amygdaloid. The cross-cut to the Kearsarge lode is out 3500 ft.; it should reach there at the end of the year.

A turbo-generator is being installed at the Champion mill, a duplicate of that which has been working at the Baltic for two years. Exhaust steam from the stamps is to drive the new engine. Ore containing 50 lb. copper per ton is coming from one of the Champion shafts.

At the South Lake mine a new steel rock-house is being erected.

The drilling scheme at the White Pine Extension consisted of holes, spaced 1000 ft. apart, so situated as to cut the copper material at a depth of approximately 400 ft. from the surface on their inclination; a second line of holes, spaced 1000 ft. apart, to cut the ore at 800 ft., and a third and final line of holes, 1000 ft. apart, to cut the ore at 1200 ft. The second line was placed half way between the holes of the first and third lines and were 250 ft. from the second line, according to Homer A. Guck.

So far, the line of 400 and 800-ft. deep holes has been completed for a distance of 15,000 ft. along the strike. In all of these none failed to find commercial ore. The first hole on the 1200-ft. deep line is completed. This shows similar formation and value, but is ⅓ wider. Drilling will be completed when the remaining 1200 ft. holes are finished. At present there are four drills working two shifts each on these deep holes. There are six drills altogether working on the property. Including the time lost in moving, the drills made about 50 ft. each per day of 24 hours. Drilling has shown the copper to be largely confined to two shale-beds that are separated by a six-foot stratum of sandstone, which is copper-bearing, but not so rich as the adjoining shale. The lower shale is the richer of the two. Drill samples of both the sludge and core show this vein to contain from 30 to 70 lb. of copper per ton. The width varies from 5 to 7 ft. The upper shale is not so uniform as the lower either in width or copper content. It varies in width from 7 to 15 ft., and in copper from 17 to 30 lb. A probable average mining width of the combined veins, which can be extracted from one drift not removing the included sandstone, will be 13 ft., and the average refined recovery based on an 80% mineral, will be 24 lb. The dip of the shale beds at the east end of the property is 85° to the vertical, flattening to a dip of 83° at a depth of 1200 ft. as shown in the first deep hole. At the west end of the property the dip at the surface is 78°, flattening slightly in depth as shown in the 800-ft. drill holes. Within 60 days drilling will be completed. Active mining operations will then start with the sinking of a large four-compartment shaft, the situation of which has already been decided on.

MISSOURI

JASPER COUNTY

Prices for concentrates were a little lower during the week ended October 16. The output of the Missouri-Kansas-Oklahoma region was 6229 tons blende, 282 tons calamine, and 827 tons lead, averaging $80.04, $50.16, and $49.16 per ton respectively. The total value was $554,117, and for 42 weeks, $18,927,053.

On account of the value of the sludge made in the mills, all of the new plants are being provided with extensive sludge departments.

A new 300-ton mill at Belville has started on tailing from the old Standard Hill mine. The plant can treat either tailing or run-of-mine ore.

MONTANA

FERGUS COUNTY

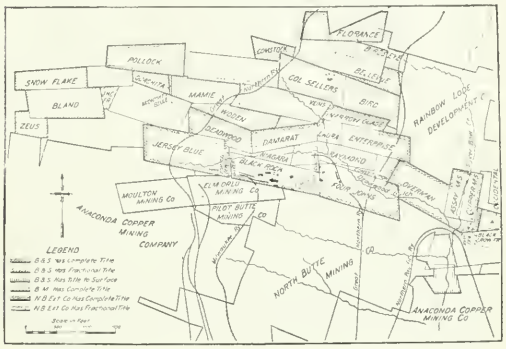
Litigation between the Barnes-King and Kendall companies has been settled by the former purchasing the latter's property for $100,000, $40,000 cash, and $10,000 per month for six months. A 400-hp. water power-plant is included, the Barnes-King for years paying $7200 per year for power supplied. The output of the Barnes-King properties will now increase.

MADISON COUNTY

A fair amount of development is under way in the Twin Bridges district, and a feeling of optimism prevails. Butte people are said to be investigating some properties.

SILVERBOW COUNTY

The Clark-Montana Realty Co.-Elm Orlu Mining Co. *v.* Butte & Superior Copper Co. suit commenced at Butte on October



PART OF BUTTE, SHOWING ELM ORLU AND BUTTE & SUPERIOR CLAIMS.

18, before Judge G. M. Bourquoin of the Federal court. It is a very important case, and a large number of famous mining men are retained by both sides. A large map of the properties is part of the evidence. The plaintiff alleges that the apex of the Rainbow lode is within its Elm Orlu claim, and that the lode passes through the Black Rock claim of the Butte & Superior. Damages are asked.

The accident at the North Butte mine last week, whereby 16 men were killed and six injured, by an explosion of powder at the surface, will not interfere with ore production, which is 1400 tons per day. The company, under a clause of the Montana compensation law, insures its own employees, and will pay the dependents of the men killed and injured as soon as possible. The cause of the explosion will remain a mystery.

NEVADA

ESMERALDA COUNTY

At 930 ft. in the Jumbo Extension the east drift shows 6 ft. of $100 ore, which is being extracted. Two new stopes have been started on the contact segment of the Jumbo Extension orebody at 918 ft. depth. Seven feet of $20 to $25 ore is being broken.

In a raise above the 100-ft. level, the New Goldfield Simmerone company has opened 4 ft. of ore assaying $525 per ton. Lessees extracted some rich ore from above this point two years ago.

At 600 ft. in the Silver Pick the east cross-cut has passed through 18 ft. of formation of low value.

At the Spearhead property two shifts are employed in unwatering the old Shale shaft, 250 ft. deep. It is to be sunk to 950 ft. to the latite-shale contact. An air-compressor and drills are to be used.

At Pioneer, the Pioneer Consolidated is employing 16 men, with more to be added. Development is satisfactory, and the mill is working well.

Humboldt County

Copper deposits are said to be numerous in this county, but undeveloped. Salt Lake people have acquired 10 claims in the Red Butte district, 15 miles north of Antelope on the Western Pacific line. Prospects are considered good.

The results of reconnaissance work in Nevada by F. L. Ransome have been published by the U. S. Geological Survey as Bulletin 414, 'Notes on Some Mining Districts in Humboldt County, Nevada.' The bulletin embodies the results of an examination of some 7000 sq. miles, including the Seven Troughs, Rosebud, Star, Unionville, Humboldt, Fitting, Chafey, Kennedy, Adelaide, Red Butte, and Coppereid districts. Some of the districts examined, such as Seven Troughs, Rosebud, and Red Butte, have been prospected only within the last decade; others, like Star City and Unionville, reached their height of productiveness in the sixties, and have not yet participated in the recent general revival of mining activity in Nevada; one or two, like Chafey, have received new names and have been exploited in various ways; still others, like Adelaide, have been intermittently active for over 35 years, oscillating between prosperity and decay. Mr. Ransome discusses the mineralogy, geology, and mining operations of the region. His conclusion is that the southern portion of Humboldt county is part of a metallogenetic province, characterized chiefly by the prevalence of antimonial ores of silver with numerous and widely scattered deposits of stibnite and cinnabar. There are in addition some deposits of gold-silver, copper, and nickel-cobalt ores. Ore deposition probably began immediately after the intrusion of the Triassic and Jurassic sediments in late Mesozoic time, by a granitic igneous rock of the same kind as that which invaded the sedimentary rocks of the Sierra Nevada at the same period and continued into the Tertiary. The known Tertiary deposits are essentially gold-silver ores and copper ores, but it is possible that some of the other types are also Tertiary.

Lyon County

Between the 100 and 200-ft. levels of the Ludwig mine of the Nevada-Douglas company, a shoot of oxide ore containing 23% copper, 7% iron, and 4.5% lime, has been cut in the limestone foot-wall. It is probably an extension of the orebody opened at 40 ft. depth.

Mineral County

(Special Correspondence.)—Copper men are sure that the present situation of the metal will mean the making of the Santa Fe district. Developments during the past few months have resulted in great optimism.

The Calavada Mining Co. has completed the cutting of a station at 1000 ft. and is now cross-cutting to the vein. This property is controlled by the Giroux interests, who will sink to water, which is expected at about 1200 feet.

Arrangements are completed for the financing of the Luning-Idaho Mining Co., and work will be started on a large scale early in November. This property lies in the belt containing the Fermina holdings, now being extensively leased; the Calavada or Giroux property, and the Duffy mines recently purchased from J. N. Bealer and associates.

Lessees in the New York Canyon area are shipping over 40 tons daily. All of this ore is considered high grade, as it must assay over 6% to pay the hauling to railroad, freight, and smelting charges, and it fairly illustrates the great possibilities of this district, when the large tonnage of low-grade ore that is left on these dumps for future times is considered.

The Nevada Gold Mines Co., Ltd., which is operating on an extensive plan, south-west of town, is opening high grade gold-silver ore. Steady production will be made this fall.

R. B. Todd has arranged with eastern people for the formation of a company to take over the Luning Gold Mines Co., and work will commence in the near future. This property has been a good producer, and has a large tonnage of milling ore blocked out.

Development at the Alameda Mines Co.'s ground is going on steadily. It is rumored that a leaching-plant will be erected there before long.

There are 20 sets of lessees working copper properties at a profit here, shipping, in most instances, ore around 5 to 10%. This ore will eventually be shipped to the leaching plant at the Nevada-Douglas at Ludwig.

Luning, October 14.

Nye County

The plan for consolidation of the principal producing properties on Litigation hill, with the Manhattan Milling & Ore Co.'s plant to be included in the merger, so that as soon as operation is started the new company will be able to treat ores in its own mill, and thus do away with the high custom mill rates, is well under way. A meeting of the owners in the mining companies interested, with Mushett and Wittenberg, who own an interest in the mill, was recently held at Tonopah, and a tentative agreement was reached between those concerned.

Kane and Whitman, lessees at the Union No. 4 claim of the Dexter-Union company, are developing a large quartz body at 150 ft. depth.

The Big Pine mill continues to treat 150 tons of ore per day, with 40c. residue. The crusher-plant receives 450 tons, but rejects 300 tons, leaving 150 tons for the tube-mill and amalgamating plant.

The Sunset Mining & Development Co. at Rhyolite is adding a Hardinge ball-mill, Dorr duplex classifier, and other equipment to its plant. The present daily capacity of 50 tons is to be doubled. From $4 to $10 ore the recovery is 90%. Developments are encouraging. The main adit is in 2200 ft., but has 800 ft. to go to reach the Denver vein.

Tonopah mines last week produced 9704 tons of ore worth $200,632. Bullion shipments were 98,112 oz. from the Belmont, 97,055 oz. from the Extension, and $56,350 from the Tonopah Mining.

The West End mill treated 1035 tons, 275 tons of which was from lessees, etc.

Since May 21 lessees at the Montana and Midway mines have produced a total of 3615 tons of ore, the week ended October 14 totaling 440 tons. This was treated at the West End mill. Two 50-ton cars were also sent to the Belmont mill at Millers. Average royalty is 22.5%. After deducting treatment the yield is $23 per ton, equal to a total of $89,000, of which the tributers received $67,300.

OKLAHOMA

Ottawa County

North of Commerce the Cornfield Lead & Zinc Co. has been drilling, and the holes have shown the richest ore in the region. Assays were as follows:

Depth, feet.	Zinc content, per cent.
210 to 213	19.33
213 to 215	15.83
215 to 217	24.65
217 to 219	22.00
219 to 221	38.33
221 to 223	61.66
223 to 225	38.37
225 to 228	7.80

UTAH

Emery County

Salt Lake City people have contracted to purchase not less than 100 carloads of manganese ore from deposits near Greenriver.

Beaver County

Little has been heard of the Fortuna district lately, but high-grade gold ore is being extracted from the Davis lease of the

Lumley and Moore ground, which is reported to have been sold to the U. S. S. R. & M. Co. There is a good road into the district.

Juab County

Ore shipments from Tintic last week totaled 121 cars from 13 properties. According to H. Wisener Hammond, who recently inspected the district, the future of the place depends on deep development, from which a number of the smaller companies should be consolidated. To supply the new motors at the Chief Consolidated and Eagle and Blue Bell mines the Utah Power & Light Co. is erecting a sub-station.

Piute County

On October 19 the Mineral Products Co.'s potash plant commenced work at Marysvale. The first shipment will be 93% concentrated sulphate of potash, packed in cotton bags. The daily output of the unit will be up to 30 tons. Higher-grade material is expected later on.

Summit County

Ore shipments from Park City last week totaled 1920 tons, as follows: Daly-Judge, 652; Daly West, 221; Silver King Coalition, 740; and Silver King Consolidated, 307 tons.

According to the *Deseret Evening News*, the treatment capacity of the State has been increased by 3000 tons per day since the beginning of the year. The new mills, their location, and daily capacity in tons, are as follows:

Broadwater, Park City	500
Big Four, Atkinson	300
Tintic, Silver City	300
Utah Leasing, Newhouse	300
Caldo Mining, Frisco	200
Park City mills, Park City	200

The following increases to capacity have been made:

Silver King Coalition, Park City	100
Utah Apex, Bingham	225
Daly Judge, Park City	50
United States, Midvale	290

WASHINGTON

Ferry County

(Special Correspondence.)—The West Virginia Mining Co., having purchased the property of the Republic Consolidated Mines (the Lone Pine, Pearl, and Surprise claims), after paying down several thousand dollars, has failed to make one installment, has forfeited its rights to the latter company, and has gone out of business. One or two of the shareholders, however, are interested in the Republic Consolidated. With this deal some machinery that was purchased by the West Virginia company has been taken over by the Republic company and removed to the Surprise mine, where it is now being erected. A. B. Willard, who is largely interested in the last-named company, has become the head of the concern, and promises prompt payment for labor and supplies. He was a fortunate investor in the Interstate-Callahan company, of Idaho. The Lone Pine-Pearl-Surprise group has proved to be a meritorious property, and, if it is well managed, should be profitable.

Z. E. Merrill & Co., lessees of the Tom Thumb group, have been shipping ore from that property, and met its first pay-day from the returns.

The foregoing is all the news from Republic, excepting operations at the Ben Hur mine, now controlled by the British Columbia Copper Co., and the Knob Hill, from which nothing authentic can be learned at present.

The 150-ton smelter formerly owned by the Keller and Indiana Consolidated Co., at Keller, is reported as sold to the Spokane Metals Co. for $50,000, to be operated as soon as repairs can be made on a water-flume which supplies the power. The Keller smelter is fully equipped with a mill, two furnaces, and modern electric machinery. The plant was built several years ago by the K. & I. C. Co., at a cost of over $100,000, but has been idle nearly ever since for want of transportation.

A rich antimony prospect at Whitestone, discovered seven years ago by W. H. Ingham and a Mr. Whitcher, is reported to have been sold for a large sum to Eastern people.

Republic, October 15.

WISCONSIN

Iowa County

(Special Correspondence.)—At Highland the Saxe-Pollard company, of Milwaukee has purchased the complete surface equipment of the Milwaukee-Highland Mining Co., valued at $20,000. An option has been taken on the Lampe-Imhoff estate, and mining operations have been started.——W. B. Seaver of Chicago is negotiating for the purchase of the holdings of the St. Anthony Mining Co., including its plant, 400 acres of land valuable for farming as well as for mining. ——Large shoots of zinc carbonate ore have been cut in drilling by the New Jersey Zinc Co., over a distance of ¾ mile. This concern has been buying extensive areas of land.

At Linden two new power and concentrating plants are being erected, one for the Saxe company, the other at the Gilman mine; a third will be built for the Optimo Mining Co. of Indianapolis.——Drills at the Gilman mine have passed through solid sheet-formations 16 to 18 in. thick. On the Rolling lease the Optimo company's drills cut 12 ft. of milling ore. A score of new producers have been developed in this district during the year.

At Mineral Point the acid department of the New Jersey Zinc Co. is being overhauled after a 4 years' shut-down, caused by damage suits. The re-constructed unit will be ready for work on November 15, and will need 150 men. The output will be one 25-ton tank-car of commercial sulphuric acid daily. Large shipments of low-grade blende and carbonate ores are arriving from western states to be converted into zinc oxide.

Eight active producers are operating steadily in the Mifflin district.——The two Coker mines, owned by the New Jersey Zinc Co., equipped with twin separating plants, are producing from 6 to 10 cars of 45% zinc concentrate per week. The ore is delivered to the separating hearths of the company at Mineral Point, the residue going to the smelter at DePue, Illinois.

Milwaukee people purpose to establish an independent smelter somewhere near St. Louis, the ore supply to come from the Wisconsin region. Already 10 zinc mines have been purchased, and deals are on for several more.

Highland, October 20.

Lafayette County

(Special Correspondence.)—At Benton the largest producing district of the Wisconsin region, the regular weekly shipments amount to 40 cars of zinc concentrate of all grades. The leading producing mines are the Frontier, Calvert, Bull Moose, and Hird of the Frontier Mining Co.; Fox and Penna-Benton, of the New Jersey Zinc Co.; Crawhall and Thompson of the Field's Mining & Milling Co.; Kittoe, Wilkinson, Martin of the Vinegar Hill Zinc Co.; and Champion of the Wisconsin Zinc Co., and Indian Mound mine. A dozen new producers will commence before the end of the year, the Wisconsin Zinc Co. controlling three of them.

The Benton Roaster Co. (Utt-Thorne Mining Co.), completed a new ore separating-plant on the first of October, costing $20,000. Besides working on ore from affiliated mines, an outlet is offered to low-grade, independent producers.

The Field's Mining and Milling Co. started a new calcining and separating-plant on the Crawhall mine.

Four miles of hard macadam road is being built by the operating concerns at New Diggings to connect with the railroad, at this station, affording an outlet at all times of the year. At New Diggings the Wisconsin Zinc Co. will have in commission on November 20 the finest type of separating-plant ever erected here, costing $75,000. Ten Dings and Cleveland-Knowles separators will be employed. The plant will handle 150 tons of raw ore every 24 hours, and will be able to make 500 tons of top-grade zinc concentrate. Thirty drill-holes on the Blackstone lease held by the Vinegar Hill Co. have cut

zinc ore. A new shaft is being sunk and a plant is contemplated.

At Shullsburg the ore from the Winskill and East End mines goes to the new Wisconsin Zinc Co.'s roasters just started at Galena, Illinois. More attention is being given to the recovery of slime, the Overstrom, Wilfley, and Deister tables being preferred.——The Milwaukee-Shullsburg mine is treating tailing.

Benton, October 20.

WYOMING

BIGHORN COUNTY

The Ohio Oil Co., a subsidiary of the Standard Oil Co., has brought in a great well at Byron, producing 140,000,000 cu. ft. of gas per day. This concern has been drilling on some land of the Utah-Wyoming Consolidated Co., and has two wells down to 1500 and 1715 ft. depth.

CANADA

BRITISH COLUMBIA

According to A. W. McCune of Salt Lake City, the lack of a market for the zinc output of the properties now operating in this province has done more to retard the industry than anything else, and it has prevented development of a number of promising prospects. The improvement in methods of treating zinc ores, together with the financial aid the Canadian government is rendering in establishing zinc smelters, promises to result in great activity.

MEXICO

CHIHUAHUA

According to C. L. Baker, legal representative of the American Smelting & Refining Co., at El Paso, Texas, the Chihuahua smelter has been confiscated by Villa, who is about to operate it. There are 2000 tons of fuel at the plant.

SINALOA

On October 26 the steamer *Grace Dollar* arrived at San Francisco, California, with Frank Perry, manager of the Lluiva de Oro Mining Co., and bullion worth $100,000. Bandits attacked a mule-train carrying the metal on September 20, but were routed by the advance guard.

SONORA

Unless the Naco or Nogales branch of the Southern Pacific railway is soon opened Cananea will be closed down again.

MAP OF MEXICO PREPARED BY THE NEW YORK WORLD, SHOWING THE AREAS CLAIMED BY THE SEVERAL FACTIONS.

There is under 15 days' supply of fuel and food in the place. Villa's men hold Cananea, Carranza's hold Naco, therefore communication is interrupted. The Nogales line is badly in need of repairs. There are no disorders at Cananea. Colonel Beltram being firm. The Greene-Cananea property was closed again on October 26.

PERSONAL

DAVID H. LADD is at Milford, Michigan.

HOWLAND BANCROFT writes from La Paz, Bolivia.

B. V. BARTON has gone from Australia to Korea.

R. A. KINZIE has been in Amador county this week.

J. H. MACKENZIE is due from Juneau on November 10.

C. B. KINGSTON has returned to London from Rhodesia.

LLEWELLYN HUMPHREYS is here on his return from Arizona.

T. C. NOBLE is returning to Butte from southern California.

H. WISENER HAMMOND visited the Tintic district, Utah, recently.

ROY H. ELLIOTT has returned from Siskiyou county to San Francisco.

ROY J. KING returned to Tonopah from Alaska, and is now in Oregon.

FRANK PERRY, manager of the Lluvia de Oro Mining Co., is here from Mexico.

DOWNIE D. MUIR, JR., on his return from Alaska, has gone to Salt Lake City.

CHARLES FARISH, on the staff of the Arizona Copper Co., is visiting San Francisco.

J. H. HEDGES, chief engineer to the Moctezuma Copper Co., is at Long Beach, California.

C. B. LAKENAN, manager of the Nevada Consolidated Copper Co., is here for a few days.

FARIS V. BUSH, of Lordsburg, New Mexico, editor of the *Lordsburg Leader*, is in San Francisco.

W. R. COX has been appointed Professor of Mining and Metallurgy in the Oregon School of Mines.

KEIJITO NISHIO, engineer of the Japanese Bureau of Mines, sailed from San Francisco for Yokohama on October 23.

L. F. S. HOLLAND has returned to Los Angeles after making examinations in Nevada, and in San Bernardino county, California.

H. C. HOOVER arrived in New York on October 24 on a brief visit in connection with the business of the Belgian Relief Commission.

FRANK H. SISTERMANS, DUNCAN M. MUNRO, and ALBERT C. SAVAGE have gone into partnership, with an office in the Mills building, at El Paso.

E. M. HAMILTON, F. A. BEAUCHAMP, and S. E. WOODWORTH have formed a partnership as metallurgists with offices at 419 Embarcadero, San Francisco.

Obituary

HOWARD E. BURTON, president of the Western Zinc Oxide Co. and a prominent and respected assayer since 1890 at Leadville, Colorado, died on October 16 at Glenwood Springs, following five days' illness with pneumonia. Mr. Burton went to Leadville in 1890 as assayer for the Elgin smelter.

Schools and Societies

The FRANKLIN INSTITUTE OF PENNSYLVANIA held a meeting on October 20, at which Heinrich O. Hofman delivered a lecture on 'Recent Progress in the Metallurgy of Copper.'

The California Section of the AMERICAN CHEMICAL SOCIETY held its 86th meeting on October 23, at the Jules restaurant, Market street, San Francisco, at 8 p.m. 'Cast Iron as Applied to Chemical Industry,' is the title of a paper by Edward J. Fowler.

The Columbia section of the A. I. M. E., which includes Idaho, eastern Oregon, eastern Washington, and part of British Columbia, with a membership of 100, is to visit Wallace, Idaho, on November 19 and 20. Interesting papers will be read, followed by excursions.

THE MARKET PLACE

Weekly Summary of Metal Prices and Notes on the Markets.

Metal Prices

San Francisco, October 28.

Antimony	37
Electrolytic copper	19
Pig lead	5.00—5.95
Quicksilver (per flask)	$93
Spelter	16
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	26

ORE PRICES

Antimony: market weaker, 50% product, free from deleterious impurities, per unit.....$1.40
Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....30.00

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, October 28.—The demand for copper is irregular; lead is firm owing to export buying; zinc is active and very strong.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct. 21	49.00	Sept. 15	48.56
" 22	49.00	" 22	48.85
" 23	48.87	" 29	49.29
" 24 Sunday		Oct. 6	49.64
" 25	48.87	" 13	49.55
" 26	48.87	" 20	49.53
" 27	48.87	" 27	48.91

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	....
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The silver market continues steady, but the weakness of exchange with England may affect it slightly. Export of silver from London to India up to October 6 totaled £3,380,250, a decrease of about 12,500,000 oz. compared with this period of 1914. India and China show no interest of late. Stocks at Bombay have increased. The stock at Shanghai on September 9 was valued at about $54,000,000, say 110,000,000 oz. Since the War began, £6,000,000 of new British coin has been put into circulation, double the normal annual addition to the currency. This used silver worth £2,150,000, say 22,000,000 ounces.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Oct. 21	17.75	Sept. 15	17.42
" 22	17.75	" 22	17.75
" 23	17.75	" 29	17.87
" 24 Sunday		Oct. 6	18.00
" 25	17.87	" 13	18.00
" 26	17.87	" 20	17.87
" 27	17.75	" 27	17.79

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	....
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended October 19 totaled 4,335,622 lb., worth $776,437. England secured 2,543,102 lb. of this and Italy 1,412,234 lb. Imports amounted to 4,634,815 lb., valued at $601,764. Peru sent 2,888,372 lb., and Canada 510,449 pounds.

It is estimated that Michigan will produce 240,000,000 lb. this year, against 230,437,992 lb. in 1905, the greatest year. The present rate is nearly 300,000,000 pounds.

Cerro de Pasco, Peru, has been re-organized by New York capital, by issuing $10,000,000 6% bonds. The present output is about 4,000,000 lb. per month. By the end of 1915 the Chile Copper Co. will be producing 7,500,000 lb. per month. By spring it will be 10,000,000 lb., at a cost of 6c. per pound. On the latter yield the monthly profit will be $1,250,000.

Braden is to issue stock to pay its debt.

Cananea is closed again by the Villa activity in Sonora.

The Calumet & Hecla-Tamarack consolidation scheme has not been agreed upon. The former offers $50 per share, but the latter's engineer estimates its value at $100 per share.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Oct. 21	14.00	Sept. 15	13.92
" 22	14.00	" 22	13.58
" 23	14.00	" 29	14.23
" 24 Sunday		Oct. 6	14.37
" 25	14.25	" 13	13.55
" 26	14.25	" 20	13.37
" 27	14.25	" 27	14.12

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	....
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

At Joplin the zinc-ore market was firm last week; production increases. The output of the Missouri-Kansas-Oklahoma region was 5277 tons blende, 240 tons calamine, and 772 tons lead, average $78.68, $51.87, and $50.90 per ton, respectively. The total value was $466,963, and for 43 weeks, $19,394,016.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Date.		Oct. 13	92.00
Sept. 29	90.00	" 20	92.00
Oct. 6	90.00	" 27	93.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	93.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.90	Sept.	76.25	91.00
Apr.	38.90	74.50	Oct.	52.00	....
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct. 21	4.75	Sept. 15	4.63
" 22	4.75	" 22	4.50
" 23	4.75	" 29	4.50
" 24 Sunday		Oct. 6	4.50
" 25	4.75	" 13	4.50
" 26	4.75	" 20	4.50
" 27	4.75	" 27	4.75

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.80	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	....
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	30.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	....
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

ANTIMONY

In the past week there has been an active demand for antimony, and prices have advanced sharply, Chinese and Japanese now being quoted at 33 to 35c., duty paid, with the domestic product at about the same figures. Not only has buying given strength to the market, but the blocking of the Panama Canal has been a potent influence in sending prices up. The 'Kroonland,' which was among the vessels delayed, had 60,000 lb. of antimony aboard. The selling trade professes to know little about domestic antimony, except that it is refined in California, although they admit that it is as acceptable as Chinese and Japanese so far as munitions are concerned.

Eastern Metal Market

New York, October 22.

Copper producers have reduced their prices, though not unanimously. Practically all of the present demand is coming from war contractors. Lake is competing with electrolytic. England has been buying in Spain to evade the unfavorable exchange rate. New mills are being equipped for the manufacture of cartridge metal, and the manufacture of extruded metal is growing in this country. The scarcity of spot and near-by deliveries of zinc continues to give strength to that metal. Lead has been sold heavily for export; some producers are well sold up, and prices have been advanced $5 per ton. Tin prices have taken a turn upward; there is no business of importance in futures, while holders of spot are not willing to sell. Antimony has been active and prices have advanced. Aluminum is scarce at 52 to 56 cents.

Large orders continue to be placed for munitions of war, and the subsequent demand for metal-working machinery is great, in fact, no diminution is shown in the volume of business. The principal orders are for rifles and cartridges, though some big shell contracts also figure. Strikes in machine-tool plants have hampered deliveries considerably, many of which cannot be made in less than nine to ten months, or even one year ahead. In Cincinnati, 26 tool builders were affected, but the trouble appears to be passing, there and elsewhere.

Steel prices are moving upward and 1.45c., Pittsburg, is the common minimum for plates, shapes, and bars, but all the mills are obtaining premiums over this price. Miscellaneous steel products are up from $1 to $3 per ton also. The problem with the steel mills is not that of getting business, but in making deliveries. All are sold up to the end of the year. The export demand is extremely heavy, especially for semi-finished steel and large bars which are used in making shells.

The movement of freight on railroad lines running into New York is the heaviest since 1907. Ocean shipments are equally as heavy.

COPPER

Producers who had been holding their copper at 18c., full terms, for many days, lowered their quotations for electrolytic on October 18 to 17.87½c., 30 days, delivered, or 17.75c. cash, New York; sales were made at the lower price. Lake has been peculiar in that it has competed with electrolytic and at times has been lower by ¼c. At present the two grades are on the same level. Even the best brands of Lake command no premium over electrolytic. Despite the decline of October 18, some of the producers continued to hold at 18.25c., 30 days, delivered, which they have quoted for many days. The continued dullness of the market has apparently given them no cause to reduce their prices, and their attitude is bolstered up to some extent by the fact that European statistics show that French and English stocks decreased 8335 tons from September 15 to October 15. The stock of fine copper in France on October 15 was 1925 tons, against 5177 tons a month previous. This showing caused Standard copper to advance in London, but electrolytic remained at the pegged price of £88. The New York market has not been without business, although the lots taken were of moderate size, and almost entirely to meet the needs of ammunition makers at home or abroad. The failure of foreign exchange to make a better response to the success of the Anglo-French war loan has been a continued cause of disappointment. Demand sterling sold on October 21 at $4.67¼. Because of the high rate of exchange England found that it could buy more advantageously in Spain, and has been doing so. The purely domestic demand is poor, and the entire consumption is not sufficient to take care of production, a condition which, in the opinion of some of the trade, is likely to result in still lower prices.

An interesting recent development is the greatly increased production of cartridge metal. This was to be expected, of course, but the growth in output is greater than was anticipated. Not only have the established mills added to their equipment, but new rolling-mills are being installed. The Western Cartridge Company at Alton, Illinois, and J. B. Wise, of Watertown, New York, are erecting new plants. The latter has a big contract with the Allies. Another development of interest is the growing use of metal-extruding presses in this country, by means of which brass and kindred metals are forced through dies by hydraulic pressure, thereby creating rods and shapes of all kinds in any length desired. The presses used formerly were made in England, but since the War started many have been made in this country, and orders for others are steadily appearing. The process is said to have many advantages over rolling.

Exports of copper October 1 to 22 totaled 13,420 tons.

ZINC

It has been a difficult matter to interest consumers in future deliveries of spelter. Up to three or four days ago they showed but little interest in any delivery, and the market was dull and easy, gathering what little strength it had from the scarcity of spot and near-by metal. In the last three or four days, however, the makers of war materials have entered the market and caused it to take on a decidedly better tone. Prices advanced ½c. between October 18 and 20. The situation was made still better by inquiry from galvanizers for first-quarter and first-half deliveries. The New York quotation for prompt shipment on October 20 was 13.75c., with the St. Louis price at 13.50c. November is quoted at about 13c., St. Louis, December at 12.50c., and first quarter at 10.50 to 11c. Brass-mill special is quoted at 15 to 15.50c. Exports from October 1 to 22 total 4203 tons.

The base price of sheet zinc continues at 16c. f.o.b. mill, 8% discount allowed for cash and carload lots.

LEAD

Heavy buying on behalf of Canadian and Russian ammunition makers, with more interest shown by war contracts in this country also, has imparted no little strength to the lead market, and it surprised none when the A. S. & R. Co., October 21, advanced its price $5 per ton, or to 4.75c., New York. Independent sellers had been asking 4.55c., New York, although the A. S. & R. Co. had quoted 4.50c., New York, and 4.42½c., St. Louis. Some of the export buying was on a basis that netted the sellers 4.75c. f.o.b., New York. Export sales would unquestionably be larger were it not for recent sharp advances in ocean freight rates. Freight room is costly and extremely scarce. The metal is bringing about 5c. per pound in London, and present conditions would indicate higher prices. Some producers are well sold up for the next two or three months. Exports from October 1 to 22 totaled 2221 tons.

TIN

The expectation that Great Britain will impose an export tax on tin continues to restrict trading in futures. Business has been fair in the past few days, and inquiries are larger, but consumers are slow in taking hold. On Monday last about 200 tons changed hands, not much to mention in ordinary times, but attractive just now. Holders of spot have changed their attitude in the last week, and are unwilling to sell, and this stand, with the steady, though small, volume of business has caused spot prices to advance. The quotation October 19 was 33.25c., and on October 20 was 33.50c. The quantity afloat October 20 was 4175 tons, and there had arrived up to that date, 1750 tons. The imports of tin at Pacific ports in August, according to a statement of the U. S. Department of Commerce, totaled 480,908 lb. at San Francisco, valued at $166,606, and 1,940,100 lb. at Washington, valued at $523,782.

BOOK REVIEWS

Directions for Designing, Making, and Operating High-Pressure Transformers. By F. E. Austin. P. 46. Illustrated. For sale by the Mining and Scientific Press. Price, 65 cents.

The author of this work is head of the department of electrical engineering at the Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire, also the author of three books on kindred subjects. In these days of the generation and transmission of high-voltage alternating current some means of reducing the pressure to one suitable for driving motors is of importance, hence the many designs of transformers. The theory, details of construction, cost, etc., are explained. The book is somewhat technical for the beginner, although amateurs should be able to follow instructions given.

Examples in Alternating-Currents. Vol. I. For students and engineers. By F. E. Austin. P. 223. Ill., index. For sale by the Mining and Scientific Press. Price, $2.40.

This work has been carefully prepared, and is published in pocket size. It contains examples dealing with wave-length, frequency, sine and nonsine alternating-currents and pressures, generators, power, power-factor, capacity, inductance, and resonance, showing the process of solution, step by step, together with the fundamental equations applying, and the necessary data properly arranged. The diagrams are very clear, greatly assisting in an understanding of the fundamental principles. Electrical engineers will find the trigonometric formulæ of value, and tables of variable quantities for frequencies from 1 to 150,000 cycles.

Mining and Mine Ventilation. By Joseph J. Walsh. P. 180. Ill., index. D. Van Nostrand Co., New York. For sale by Mining and Scientific Press. Price, $3.

The author is mine-inspector at Wilkes-Barre, Pennsylvania. He has aimed to present a graphic form of studying mine-ventilation, based more clearly on the fundamental laws of physics and chemistry. The first half of the book is taken up largely by explanations of the physics relating to gases, pressures, heat, etc. The theorems and principles of ventilation, methods of determining the proper size for a fan, are stated fully, together with formulas and examples. Although the subject of mine-ventilation has received more attention at coal-mines that at metal mines, there is an increasing tendency to provide for it at large up-to-date metal mines, particularly where heat is a factor. Thus the Copper Queen mine recently put in a system of mechanical ventilation, using the pressure system rather than the exhaust system.

Test Methods for Steam Power-Plants. By Edward H. Tenney. P. 224. Ill., index. D. Van Nostrand Co., New York. For sale by the Mining and Scientific Press. Price, $2.50.

A working exhibit at the U. S. Bureau of Mines' exhibit at the Palace of Mines, Exposition, San Francisco, shows the efficiency of power-plants, using coal, in an impressive manner. In his introduction to this book, which has been prepared as a reference for power-station engineers, superintendents, and chemists, the author says, "Highest economy in the modern steam power-plant is to be gained only through an accurate knowledge of all conditions as they exist throughout the station, both in regard to the materials used in the production of power, and in regard to the equipment itself." Thereupon he discusses the purchase and testing of coal, economy of combustion, boiler water, evaporative tests, testing prime movers, and testing lubricants, all vital subjects for the power engineer. Coal is no longer bought as it was years ago, and power companies demand high-grade fuel. Proper combustion is necessary if efficient results are expected from coal. Boiler water is more or less always a worry to steam users, and the tests and treatment given will be found of value. Evaporative tests should be part of the work of a steam-plant, so here they are discussed; likewise testing turbines. Good oils and greases are indispensable for smooth running of machinery, and their qualities are herein described. The appendix contains the usual tables. Altogether a handy book to have around a plant.

RECENT PUBLICATIONS

Mineral Production for 1914. With mining law appendix. Bulletin 70. P. 184. Maps, index. California State Mining Bureau, San Francisco, 1915. A summary of this appeared in the Press of October 16. All California mining men should secure a copy for reference.

Strength Tests of Structural Timbers Treated by Commercial Wood-Preserving Processes. By H. S. Betts and J. A. Newlin. Bulletin 286. P. 15. Illustrated. U. S. Department of Agriculture. Washington, D. C., 1915. An abstract of this paper appeared in the Press of October 30.

U. S. Bureau of Mines, Washington, D. C., 1915.

Safety in Stone Quarrying. By Oliver Bowles. Technical Paper 111. P. 48. Illustrated.

Saving Fuel in Heating a House. By L. P. Breckenridge and S. B. Flagg. Technical Paper 97. P. 35. Illustrated.

Abstracts of Current Decisions on Mines and Mining. October 1914, to April 1915. By J. W. Thompson. Bulletin 101. Law Serial 5. P. 138.

Inflammability of Mixtures of Gasoline Vapor and Air. By G. A. Burrell and H. T. Boyd. Technical Paper 115. Petroleum Technology 26. P. 18. Illustrated.

A Bibliography of the Chemistry of Gas Manufacture. By W. F. Rittman and M. C. Whitaker; compiled and arranged by M. O. Howard. Technical Paper 120. P. 29.

Analysis of Natural Gas and Illuminating Gas by Fractional Distillation at Low Temperatures and Pressures. By G. A. Burrell, F. M. Seibert, and I. W. Robertson. Technical Paper 104. P. 41. Illustrated.

U. S. Geological Survey, Washington, D. C., 1915.

Production of Lime. By G. F. Loughlin. P. 11.

Production of Silica. By Frank J. Katz. P. 6.

Manufacture of Coke. By C. E. Lesher. P. 56.

Quicksilver in 1914. By H. D. McCaskey. P. 18.

Production of Feldspar. By Frank J. Katz. P. 7.

Production of Peat. By Charles A. Davis. P. 11.

Gems and Precious Stones in 1914. By Douglas B. Sterrett. P. 40.

Phosphate Deposits of Florida. By George Charleton Matson. Bulletin 604. P. 101. Ill., maps, index.

Anticlines in the Clinton Sand Near Wooster, Wayne County, Ohio. By C. A. Bonine. Bulletin 621-H. P. 12. Maps.

A Reconnaissance for Oil Near Quanah, Hardeman County, Texas. By Carroll H. Wegemann. Bulletin 621-J. P. 7. Illustrated.

Geology and Oil Resources of the West Border of the San Joaquin Valley North of Coalinga, California. By Robert Anderson and Robert W. Pack. Bulletin 603. P. 220. Ill., maps, index.

Mineral Resources of Alaska. Report on progress of investigations in 1914. By Alfred H. Brooks and others. Bulletin 622. P. 380. Ill., maps, index. Abstracts from this publication have appeared in the Press.

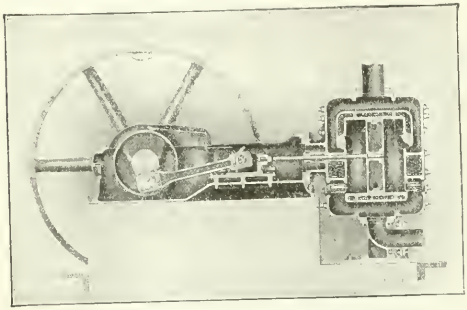
New Machines and Devices

Information based on letters and catalogues from manufacturers.

A New Vacuum-Pump

Vacuum-pumps are generally necessary in power-plants and metallurgical plants, in the latter where filtration is in vogue. For maintaining a vacuum, and for general service in other lines where a high degree of vacuum is desired, the Ingersoll-Rand Co., 11 Broadway, New York, has recently introduced a complete line of steam and power driven, duplex type, Imperial vacuum-pumps.

In general design these machines follow that of the Imperial air-compressors, a type with which engineers and power-plant operators are long familiar. The vacuum cylinders, as will be seen from the sectional illustration, are somewhat different from these ordinary ones. The intake valves are of the Corliss type, so placed in the cylinder head that the clearance is very low. This is a desirable feature, as the air trapped in the clearance spaces at discharge pressure will not reach such a volume, upon being expanded to intake pressure, as to greatly



THE NEW VACUUM-PUMP.

limit the pressure reduction that may be obtained. The action of the valve is positive and quick, and its action being independent of the cylinder and intake pressures, the pressures within and without the cylinder are as nearly equal as possible. The intake ports are large and direct, which, together with the water-jacketing of the valve, tends to cool the intake gases.

The discharge valves, which are of the direct-lift poppet type, are placed in the bottom of the cylinder heads, so that any entrained moisture or water is immediately discharged, a safety feature. Clearance at the point of discharge has been reduced by making the valve partly fill the port in the cylinder head. The discharge passages are also water-jacketed.

The cylinders are said by the manufacturer to meet fully the requirements of satisfactory and efficient operation. The air passages are unobstructed. Tie-bolts pass from head to head, and hold cylinder and heads tightly assembled. Both cylinder and heads are completely water-jacketed, which is said to be an essential feature in the design of vacuum-pumps, as the high ratios of compression tend to create high discharge pressures unless the heat is removed as generated.

Owing to the features described, the manufacturer guarantees the easy maintenance of a vacuum of within a half inch of barometer.

The running gear, that is, the main frame with its enclosed reciprocating parts, the crank-shaft, connecting-rod, cross-head, valve gear and wheel on both belt and steam-driven machines are of the same design as the Imperial air-compressor. Lubrication is by the bath system, providing automatic flood lubrication, yet retaining by the removal of covers from the casing, all the points of accessibility of the open type of machine. When operating, the fly-wheel is practically the only visible moving part, yet the entire mechanism is readily accessible while in motion.

The Imperial pump occupies less floor space than similar capacity machines of the straight-line type, due to its duplex construction, and to the fact that its speed of operation is higher.

These machines are built in capacities from 798 to 7048 cu. ft. per minute, both for atmospheric and low-pressure (5 lb.) discharge.

Commercial Paragraphs

Expansion-joints, tubular-heaters, and cloth-filters are the subjects of Bulletins 11, 13-A, and 14, respectively, of C. F. Braun & Co., San Francisco.

The American Cyanamid Co. announces the opening of its general offices at 200 Fifth avenue, New York City. The Nashville and Buffalo offices are closed.

The Oliver Continuous Filter Co. reports that it has sold two 12 by 12 ft. machines to the Anaconda Copper Mining Co., and one 10 by 12-ft. to the Dietsgen Copper Co., Alaska.

Hamilton, Beauchamp, Woodworth, Inc., metallurgical engineers for flotation and cyaniding, mill design and construction, have a test plant at 419 The Embarcadero, San Francisco.

The adaptation of Parral tanks for oil flotation is the subject of a 10-page pamphlet by Bernard MacDonald of Los Angeles. It includes two pages on the Parral tank system of agitation.

In Bulletin 1432-A, of 52 pages, the Allis-Chalmers Manufacturing Co. of Milwaukee, Wisconsin, has published an interesting lot of matter about its stamp-mills and accessory machinery for free-milling gold ores. Needless to say that the latest is given, including cams and cam-shafts, wood and iron guides for stems, screens, feeders, shaking copper tables, amalgam squeezers, California batea, clean-up pans, retorts, molds, and pebble granulators for re-grinding middling for concentration. Complete specifications give the necessary equipment for a 10-stamp mill.

The Westinghouse Electric & Mfg. Co. announces the following more important among the large number of awards received at the Panama-Pacific Exposition: The grand prize, the highest possible award, on the 4000-hp., 650-volt, direct-current, double-unit Pennsylvania electric locomotive mounted on a turntable under the dome of the Palace of Transportation; the medal of honor on alternating-current and direct-current industrial motors and control apparatus, on precision instruments, on Le Blanc condensers, on motor-generator sets for moving-picture machines, and on high-voltage oil-switches; the gold medal on a number of different classes of apparatus among which are steam turbines, alternating and direct-current generators, alternating and direct-current railway motors, transformers, rectifiers, starting, lighting, and ignition systems, switchboards and accessories, and mining locomotives; a number of silver medals and bronze medals were also received; and the Company was also awarded the gold medal for the most complete and attractive installation in the Palace of Transportation.

EDITORIAL

T. A. RICKARD, Editor

WAR ORDERS are helping 'preparedness,' by causing munition plants to be brought to a high pitch of efficiency.

COPPER EXPORTS of 25,359,000 pounds during the week ending October 16 constitute a record. Of this export France took 11,603,000, England 6,460,000, and Russia 4,625,000 pounds. In March 1914 the export of copper reached 96,519,947 pounds.

ACTIVE demand for all the metals characterizes the New York market, as will be seen from the interesting letter by our regular correspondent on Manhattan island. We believe his quotations of metal-prices to be more reliable than any others accessible to the public.

THE kind of oil to be used in flotation has been determined largely by the local supply; thus eucalyptus oil is employed in Australia, camphor oil in Korea, and pine oil in Utah. The testing of oils will become a part of the duty of the flotation chemist, for the adulteration of oils is common.

SUBSCRIPTIONS received by us in aid of Russian refugees at Moscow, in response to the telegraphic appeal of Mr. E. T. McCarthy, published in our issue of September 18, amount to $1000. We have remitted $700 to Mr. H. C. Woolmer at Moscow, and hope to be able to send as much more.

HEAVY consumption of steel presages a larger demand for copper. It is estimated that the orders for munitions of war already placed in the United States will consume an amount equivalent to 10% of the copper production, 7% of the spelter output, and 20% of the lead production in this country in 1914.

SEVERAL readers have written to correct the error made in the article on 'Soroche and Verrugas,' in our issue of October 2, wherein a railway "from Valparaiso to Oroya" was mentioned. Valparaiso should be Callao. We cannot pretend that it was a typographical error; both the author and the editor knew better, but overlooked the blunder. We thank those who were kind enough to take the trouble to write on the matter.

CYPRUS, which has been offered to Greece by England in exchange for active military support, is interesting to the miner as one of the ancient sources of copper; in fact, the word 'copper' is derived from the Greek equivalent for Cyprus, namely, *kupros*. And it produces copper still. A recent consular report, from Alexandria, states that an American syndicate is operating at Skouriotissa, in Cyprus, by permission of the Government, and expects to build a railway from the mines to the port of Karavostassi. It will interest our readers to know that the syndicate consists of two American engineers.

MEXICAN affairs have made no progress worthy of mention during the past week, but the fighting in progress at Aqua Prieta, just across the border from Douglas, Arizona, promises to end the career of Villa. Should he be defeated and his forces dispersed, we may hope for a rapid improvement in political conditions throughout Northern Mexico.

WE extend our compliments to Mr. Charles McC. Anderson, who is keeping his flag flying over the office of the *Mexican Mining Journal* even in days so catastrophic, especially in Mexico, Poland, and Servia. In the last issue of his journal we note sundry interesting ruminations by Colonel Tepetate. The last one recorded strikes a responsive chord: "I wish I could hibernate, like a woodchuck or a bear, for a couple of years. This [world] is no place for a man of sense."

DURING recent weeks our outer office has received an extraordinary number of new subscriptions, eclipsing all previous records. Undoubtedly some of them were due to the resumption of prosperity in mining; but we also like to think of them as partly the result of a wider appreciation of the efforts of our contributors, correspondents, and editors to make the PRESS interesting and helpful to the men who have to do with mines, mills, and smelters. We extend a hearty welcome to the new readers.

ACCIDENTS in metallurgical works is the title of a report just issued by the United States Bureau of Mines. It covers the years 1913 and 1914. During that period 119 men were killed and 2285 seriously injured in smelters and mills, representing rates of fatality equivalent to 1.55 and 29.67, respectively, per 1000 men employed. The report does not include returns from all the plants in operation; notably it excludes iron blast-furnaces; but the statistics show a progressive gain in their approach to completeness and afford another evidence of the good work being done by the Bureau.

PATENTS are numerous in these days. We give notes concerning the most recent issued to metallurgical inventors. Among them are several kinds of flotation apparatus, one patented by Messrs. A. H. Higgins and W. W. Stenning, of Minerals Separation, Ltd., another by Mr. Robert S. Towne, and a third by Mr. Thomas M. Owen, who has applied his inventive ability to preferential flotation. Among the crushing devices is a modifica-

tion in his ball-mill by Mr. Frank E. Marcy, and among dewatering machines is one by Mr. Wilton E. Darrow, both names familiar to mill-men. Indeed the list we publish in this issue is particularly interesting.

OUR London contemporary, *The Mining Magazine,* has come into conflict with the Institution of Mining and Metallurgy over the project to start a register of reports and other information on mines. Whether engineers have a right to dispose of a report, other than to the client for whom it was made, is a moot question, concerning which we are asking for an expression of opinion. It may be that the starting of 'The Mining Register' was not timely; it may be that it transgressed sundry British notions of propriety; but it did receive considerable support from both sides of the Atlantic and it was meant to be of service to the profession. However, the Institution saw fit to interfere in the matter. This is interesting as indicating the recognized authority of the Institution in professional affairs. No technical society in America could expect successfully to call the publisher of a technical periodical to order under like conditions, and while the Institution has made good its objection, may we not assume that this result was due largely to the good sense and professional spirit of those controlling the *Magazine?* We do assume it, confidently. The episode does credit to both.

THE discussion columns are enlivened this week by a letter from Mr. H. Stadler replying to sundry comments and criticisms on his paper explaining the mechanical efficiency of crushing. Certainly he makes a crushing rejoinder, illustrating an extreme phase of the law of Kick, of which it may be said that it is more truly "Stadler's theory" than what is commonly known as Kick's law. Whether Rittinger's theory, on the other hand, is "the law of cracks, or cranks" we leave Mr. Stadler's opponents to decide, but it is quite evident that either form of statement is beyond the reach of apparent typographical error. We submit that Kick's law, or the law of Kick, is being stretched to "the elastic limit" and that it may lead not only to the fracture of prisms but to the cracking of the cocoa-nut that crowns *homo sapiens.* However, we are grateful to Mr. Stadler for giving a touch of real life to our pages. We undertake to respond for Messrs. Kenney and Del Mar so far as to say that both of them, of course, would have been highly offended if Mr. Stadler had "completely ignored" them; indeed, the measure of their gratification will now overflow, seeing how thoroughly he has attended to them. Yet we hasten to say that Mr. Stadler is personally known to the present writer as a diffident and amiable investigator who always leaves his gun at home on the piano when he attends a scientific meeting. He is the quietest mannered man that ever sunk a submarine or exploded a mine under a hostile batallion. And what is much more to the point he understands his subject and is as keen in the search after truth as a golfer after a lost ball. Therefore, gentlemen, Messrs. Kenney and Del Mar, count twenty before you reply; please make your counter-attack without the use of chlorine gas, hand-grenades, bombs, or any weapons not recognized by Hoyle, Cavendish, or the other authorities on the game.

PUBLICITY AGENTS have proved such a useful adjunct to theatrical companies and other enterprises that depend on public support that the idea involved has been adopted by a surprising variety of organizations. The Standard Oil Company, for example, employs an agent whose duty it is to see that such facts regarding that corporation are published as well serve to correct misleading or malicious, or even true, assertions made by the scribes of the daily press. Most of the Government bureaus at Washington retain alert men whose duty it is to employ all available means to acquaint the general public with what is being done by these bureaus, the purpose being twofold: to familiarize the community at large with the knowledge that has been made available, and to create the impression that the country is getting a useful return for the expenditure of national funds, thus paving the way for appropriation for the continuance of the work. Universities, especially those supported by the State, make use of publicity men to the same end. On the whole, a good purpose is served by these activities, and the general idea is commendable. Its practicable application, however, has introduced some marked disadvantages. A pocket-knife may be a useful present for a small boy, but when it is first given to him he is likely to try it on the furniture and other objects considered by his parents unsuitable for whittling. The fundamental trouble is the difficulty of securing a man with the right combination of qualities for the work of publicity. Sometimes a member of the organization is detailed for the purpose, with the usual result that, not being a practised writer, he is unable to present the facts in a way sufficiently interesting to warrant publication of them, or to induce the public to read them. In other cases an ex-reporter is employed who is able to make his loose matter readable but objects to being handicapped by facts. The former does not succeed in obtaining publicity; the latter obtains publicity of an undesirable sort, which sometimes serves to make ridiculous, in the eyes of serious men, the organization that he represents.

Kyshtim

Mining in Russia, particularly in the hinterland of Siberia, has not suffered from the consequences of the War as much as regions nearer the scene of hostilities; in fact, some of the consequences of "the pentecost of calamity" have been favorable to those operating in Siberia. A fair example is afforded by the experience of the Kyshtim Corporation, a copper-mining enterprise developed by English and American capital, under the guidance mainly of American engineers. At the beginning of the War a shortage of labor was caused by the mobilization of one-third of the employees; at the same time both railway and ordinary road transport became precarious. The supply of coal, used in smelting and

mining, was commandeered by the Government. This came from a colliery 55 miles from Kyshtim; since then the company has exercised an option on coal-lands only 2½ miles from the main line of railway, and thus has opened up an abundant supply of the requisite fuel. As our readers are aware, the Russian import duty on copper gives the domestic producer a net bonus of £30 or $145.50 per long ton above the London or New York price. Up to July 13, 1915, the Kyshtim Corporation obtained £102 10s. per long ton, or 22 cents per pound, for its copper, this being £10 or $48.50 better than the average for the whole of 1914. In August this year the price obtained was £133 per ton, or 28½ cents per pound, so that in this respect the War has proved a favorable factor. Moreover, the Kyshtim Corporation has been requested by the Russian government to erect works capable of producing 8000 tons of sulphuric acid, the cost of this plant to be advanced by the Government. At the annual meeting of the company in London it was stated that the first two years' output of this acid has been purchased already at a satisfactory price. Large orders for pyrite, as a source of sulphur, have been placed by the Government, hence the production of this mineral has been increased to 1000 tons per week. Finally, the Government is negotiating with the company with a view to the manufacture of munitions, as the Niaspetrovsk iron foundry of the Kyshtim Corporation is well equipped and is famous for its beautiful wrought-iron products. During the last financial year the Kyshtim produced 7588 long tons of copper, which, with the iron and timber output, yielded a gross output of £1,059,523, of which £367,443 was net profit. The consulting engineer, Mr. R. Gilman Brown, estimates 2,031,000 tons in reserve. In 1914 the average yield was 2.87% copper, besides 1.8 dwt. gold and 1.1 oz. silver per long ton. This group of mines is said to be in a position to produce 10,000 long tons of copper per annum. The cost of cathodes in 1914 was £42 1s.10d., against a sale price of £92 10s.10d. per ton of copper, so that the margin of profit was handsome.

The Strike in Arizona

The relations between capital and labor are difficult to discuss, because they involve not only an economic but a political problem. Any frank discussion is bound to give umbrage to one side or the other, usually both. No statement intended to be fair can proceed far before it begins to tread on the intellectual corns of the disputants. Yet we deem it a duty to ventilate the subject, believing that we may be able, from our detached point of view, to contribute to a better understanding, at least among mining engineers, who stand between the upper and the nether millstones of capital and labor.

The strike in Arizona is a good example of such disturbances. It continues without hope of early settlement. The Department of Labor, we are glad to see, has ordered an investigation and a commissioner has been ordered to Clifton, to co-operate with two representatives of the copper companies and two representatives of their employees. While it is difficult to ascertain the facts, it would appear as if the men had some cause of complaint in the low rate of wages. Underground labor, mostly Mexican, was being paid as low as $1.75 per day, on the basis of 13-cent copper. This compares with a minimum of $3 per shift for white miners at Miami or Butte on the same market basis. But the comparison is misleading on account of the cost of living. That is a mistake often made. For instance, a miner in North Carolina may live better and yet save more on $2 per day than one receiving $4 per day in Montana. The cost of living varies enormously between different mining communities. Thus the white miners on the Rand get the equivalent of $6.50 per day, but the purchasing power of money at Johannesburg is so much smaller than it is at Grass Valley, for instance, that the same man in the latter district working at half the Rand rate will have more to show at the end of ten years. The rate of wages is a local question. From the manager's point of view a direct comparison is unfair because of the vast difference in efficiency. The Mexican labor employed in Arizona is not nearly as good as that obtaining in Montana; the white miner is bigger, stronger, and more intelligent than his fellow-human from beyond the Rio Grande.

The rate of wages prevailing at Clifton and Morenci might not have precipitated a strike if the cost of living had not been increased to the Mexicans by the fees exacted for hospital and water service, and by the compulsion to buy their food and clothes at the company store. This is not the first time that the store business of mining companies has proved an irritant; it is apt to be conducted with much of the clumsiness of municipal and governmental efforts to manage public utilities, and its real profit is not usually disclosed with any degree of frankness in annual reports, in which charges for depreciation and other devices of book-keeping tend to obscure the real results. On top of the store nuisance, the Mexicans complain that the wages paid previous to the strike varied under different foremen, leading to discriminations that were frequently irritating and not always just.

There is another phase to be considered: the operations of the three companies are variously remunerative, so that they are not alike able to pay higher wages. Although the Shannon Copper Company made a profit last year, it has operated on a narrow margin for many years previous; the other two are believed to be in a healthy financial position, notably the Arizona Copper Company. Regarding the Detroit not much is known, it being a subsidiary of a much bigger corporation, Phelps, Dodge & Co. Undoubtedly a minimum scale of $3 per shift, for underground work by Mexican labor, would compel the Shannon to cease working. Again, miners usually have exaggerated notions of the profitableness of operations. So has the public. Both overlook the big sums of money spent on development and plant; they hear about dividends, but they fail to recognize that until the capital has been redeemed—and that does not happen soon or often—the dividends represent merely a return of the

original investment, or, more correctly, the primary stake in the speculation. The equipment, which may represent millions of dollars, goes to the scrap-heap when the mine is worked out, usually sooner, for both plant and equipment have to be replaced at relatively short intervals. These factors must be considered by a dispassionate inquirer, but they are, not unnaturally, ignored during the heat of a strike. So also is the fact that the cost of working rises wherever and whenever a spirit of discord and mutual recrimination obtains in any industrial operation. A strike, whether won or lost, is a heavy tax on both sides, like warfare itself. Any adjustment finally effected is usually such as could have been made peaceably without the loss of time and temper.

Law and Patents

Flotation is represented in this issue by a second instalment of the transcript of oral argument presented in the recent trial of Minerals Separation *v.* Miami. Under date of October 16 we gave an excerpt from the speech by Mr. Walter A. Scott, of counsel for the defendant; on this occasion we give excerpts from the speeches of Messrs. Henry D. Williams and W. Houston Kenyon, counsel for the plaintiff. We publish these because they are not accessible to our readers and because they are highly illuminating, not so much as throwing light on the merits of the case under litigation, but as affording a reasoned discussion of the scientific principles involved. The colloquies between counsel and Court are particularly interesting, for they illustrate the effort of clever laymen to understand physical phenomena of an obscure character. The judge, of course, knows nothing about the recent technology of the subject; the lawyers have learned most of what they know from the expert witnesses on their own side; some of the lawyers and some of the witnesses have taken part in previous suits involving the same questions, so that they have become thoroughly informed concerning the main points at issue. A big lawsuit is an education in itself. As for the witnesses, many of them are directly interested in the decision, they are either partners or employees of the litigants, so that their testimony becomes skilful advocacy. Even the outside witnesses, or experts, are retained by one side or the other, and, however scientific in their first attitude, they must become thoroughly partisan as the case proceeds. Thus the entire effort of arriving at the truth is severely handicapped; it is a clumsy method of trial, consisting essentially of the delivery of a large mass of partisan evidence before a judge inexpert in the science of the patents and operations involved. At the same time, we must recognize that all human experience goes to show that one of the best ways of arriving at the truth is for two partisans to argue their case before an impartial third person. But that third person might well be versed in the subject matter of the dispute, so as to understand the evidence, as well as the arguments, of the two disputants.

The metallurgist may be forgiven a feeling of impatience, if not disdain, at the whole performance. Why should not the Court consist of one or of three scientific men of special experience, why should not the witnesses be chosen and retained by the Court, still keeping trained dialecticians, namely lawyers, to argue the case? The answer is that the issue is primarily one of law, not of technical science. Then perhaps a good compromise could be effected by having special judges with scientific and technical knowledge to sit in such patent cases. As to the witnesses, of course, nobody can deny that these should not be in the pay of either litigant but retained by the State. Such a scheme would in time produce men of proved intellectual honesty, keen scientific insight, and judicial temper. Meanwhile we must accept things as they are and acknowledge that these flotation cases have been tried with great skill on the part of all concerned. But does it not seem absurd when the Government gives the inventor a specific privilege, namely, the right to use or lease his invention, that he should be put to such expense and trouble in protecting the right previously accorded to him by law. Manifestly, the Government should not grant the privilege without thorough investigation, without advertising for objections, without the fullest publicity to all concerned, but, having once given the privilege, the Government should stand behind the patentee and protect him fully against infringement. Next, it should assume the duty of specifying the proper royalty to be collected by the patentee, modifying the impost from time to time according to circumstances and preventing an excessive imposition. Perhaps also it might be well if the Government took part of the royalty to meet the expense of the special administration required in such matters. If these things were done, then, of course, any quarrels over patent-rights would come for adjudication before the Patent Office administration, which, by that time, would include a court suitably equipped to try such cases. As it is now, not only do we have scientific problems discussed before non-scientific tribunals and hired witnesses, not only is the patentee helpless to prosecute infringements unless he is also wealthy, but the very act of patenting is a farce. In applying for patent an inventor is supposed to state plainly what his invention really is, and to explain clearly what is the nature of his claim. In fact, many patentees—including some of those privileged to use certain phases of flotation—take care to give as little information as possible and to render their description of the minimum practical value. That is why an infringement may be an innocent infraction of the patent. This failure to give explicit information marks an effort by the patentee to protect himself in default of protection from the Government. In the case of flotation, it is obvious that many of the obscurities of phraseology are due to the obfuscation of the patentee's mind, for most of the supposed inventions have been made not by deduction from scientific principles, but by 'trial and error,' by the 'hit or miss' of laboratory empiricism, yielding results that the patentee is not able to explain and leading to inferences that he is unable to maintain. So, once more, we rise to remark that the patent law is an excavated anachronism.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

The Mechanical Efficiency of Crushing

The Editor:

Sir—At first I was of opinion that the two articles recently published in your paper by Mr. H. C. Kenney and Mr. Algernon Del Mar were not worthy of a reply. However, having paid so much attention to a paper of Mr. A. O. Gates on the same subject, just now under discussion before the American Institute of Mining Engineers,† they might feel offended if I should completely ignore them.

Mr. H. C. Kenney* was one of those who lectured to Mr. Gates on his failure to realize that in the case of shearing, mentioned by him, a change of configuration would infallibly precede final rupture. Immediately after he plays the same trick in a better disguised form. He cuts the cube by a "sharp and strong theoretical knife (since we are dealing in theories) that would sever the molecular bonds without causing compression or distortion." The theory of the action of the knife is that of the wedge, the effect of which can easily be studied by cutting a piece of cheese. I am quite prepared to see the next expert turning up with a theoretical saw to prove that the work expended is proportional to the area of fracture.

The tests made at the Watertown Arsenal, referred to by Mr. Kenney, plainly demonstrated that the crushing strength of cubes, that is, the stresses per unit-area (not "the force to rupture cubes" as stated by Mr. Kenney) was a constant for any given material independent of the size of the cube. It was further proved by a series of tests made on similar prisms that the work varied as the volume, giving thus the *dementi* to Mr. Kenney's statement that "Stadler's theory (he means, of course, Kick's law) has nothing to do with prisms." It is, of course, for quite another reason that these tests are quoted. Two figures are picked out showing that less pressure was required to crush a cube than a flat prism of half the volume, while, "according to Mr. Stadler," just the opposite should have taken place. Even with a sketch under his nose, Mr. Kenney is not aware that a cube and a flat prism are not geometrically similar bodies and that the law could therefore not be applied. On the other hand, as the comparison of the crushing strength of dissimilar bodies showed that the breaking-load of the prism was greater, it follows from the application of Kick's law that a flat prism opposes a greater resistance to crushing than a cube of the same volume.

No scientist of standing has yet committed himself to a definite wording of the law expressing the so-called Rittinger's theory and each writer is therefore at liberty to make a version of his own. In Mr. Kenney's opinion "Rittinger's law in no way states that the work to rupture a cube is not proportional to the volume of the cube, neither does the law state that the work done is proportional to the diameter or square of the diameter of the cube ruptured. The law states first of all that the work done is proportional to the surface exposed in the operation," or putting it more briefly in the words of Mr. Gates: "Rittinger's theory is the law of the cracks" (cranks?). However, it must follow, that from the moment the work varies as the fractures exposed, as claimed above, it is bound by force of logic to vary also as the reciprocal of the diameter or inversely as the diameter, or as the square of the homologous dimensions; in fact, as any other series that varies at the same ratio. It would even vary as the mortality of children over certain ages if it should happen that the death-rate over that period should be the same.

For preventing misunderstandings it must always be kept in mind that any crushing law can be expressed in two different ways according to its referring to the work expended for reducing the whole of a body from its original size to a final size, or to the work required to cause the fracture of individual sizes. In the first case the work to be expended increases with the fineness of the final product in the proportion specified by the law and in the second case it decreases with the size of the body in quite a different proportion.

By following up his knife-theory Mr. Kenney arrives at the following startling conclusion: "As the cut becomes nearly complete, the potential energy of compression changes to work of fracture and the work of compression is lost as such." Before, we were told that by applying a knife no compression would take place and now he states that at the yield point (he means, of course, the limit of plastic deformation, or upset point) the work of compression changes to work of rupture, the former varying as the volume and the latter as the fractures. The curve of the total work expanded would in this case be a composite one, which it would be difficult to express in one formula. This difficulty, however, does not exist for resourceful men such as Mr. Kenney and Mr. Del Mar; they simply add the two equations and at the conclusion of the performance of some further

*M. & S. P., April 10, 1915.

†Trans. A. I. M. E., September, 1915.

algebraic parlor-tricks, Mr. Kenney triumphantly announces to the startled crowd: "Here is the agreement between the laws of Kick and Rittinger, showing how the work necessary to break cubes of the same material is at once proportional both to the volumes and the surface exposed by the break." The blunder of adding two laws is just as appalling as the error committed in this particular case is infinitesimally small, because the second portion of the curve expressing "the law of the cracks" is practically *nil*, considering that the distance through which the force has to move for severing the molecular bonds cannot be greater than the radius of molecular attraction. By observation of the happenings during the crushing of a specimen in a testing machine not the least indication of a critical stage immediately preceding the moment of actual rupture can be discovered. The strain-stress curve demonstrates that the force at the end of the operation of crushing approaches its maximum in a regular slowly-rising curve and at the same time the compression is vanishing and therefore also the work. In fact, the addition of a single grain of shot to the weight is sufficient to perform the act of final rupture, which consequently is nothing else than the ultimate end stage of the operation of compression.

Mr. Algernon Del Mar, lying sick in the same hospital as Mr. Kenney, displays an even more disquieting lack of technical training in his confused recent article.† He, too, differentiates between the work of compression and the work of fracture and, like his congenial friend, he handles the laws of work as if they were algebraic quantities. As a deterring example of technical twaddle the article merits re-printing in full, but the quotation of the conclusion will suffice to reveal the frame of mind of its author: "I have, I believe, shown that while Kick's law is true to the elastic limit, beyond Rittinger's law is approximately true for fracture, and the difference of the two amounts of work (!) is made up of several factors that vary with the size of the particle to be crushed."

With little respect for his theoretical achievements Mr. Del Mar is aware that this subject should "not be left to mathematical jugglery," but decided by experiments. Mr. Gates and Mr. Kenney are equally impressed by this necessity, but all three completely ignore that it is precisely by exhaustive experimental work carried out in well equipped testing laboratories by qualified experts that all these problems were solved and definitely settled—half a century ago.

H. Stadler.

Royal School of Mines, London, October 2, 1915.

Saving Fine Gold

The Editor:

Sir—I have read with much interest the various articles which have appeared from time to time on the subject of concentrating placer material. The purpose is to save the gold and platinum that exist in a very fine state of division and in the form of thin plates. Metal in these forms occurs in the black sands and cannot be separated from them by means of the usual sluice and riffle. The best that can be done is to save the black sand and then, after concentrating the metal in a part of the black sand, separate the portion of the black sand that has little or no value, and ship the rich sand to a refinery or smelter.

Such concentrating plants appear to have been more or less successful. As near as I can determine, where they have failed it has been due to known causes, as follows: (1) High charges for refining; (2) high cost of freight; (3) inefficient concentration plant; (4) high ratio of concentration, by which much of the metal went over in the tailing and too much expense for concentration was incurred.

After about six years' study of this problem, accompanied by practical test at various mines, I have arrived at the following solution: The sand is worked in two stages on account of the uneven feed from the sluices; it is fed from an undercurrent onto a roughing table and from this passes into a bin or tank where it is dewatered to some extent. A regulated feed of sand and water is then passed to a finishing table. From this a $20 concentrate is passed over an amalgamated silver plate which has riffles resting on its surface. The ends of these riffles are fastened to narrow strips of wood about three feet long, forming a sort of rack that can be moved along on the plate so as to utilize every part of the surface. These racks can be taken off with the plate with one movement when it is desired to clean-up.

The riffles furnish a succession of drops the importance of which in saving fine gold is commented upon by R. H. Richards in 'Ore Dressing,' and other authorities. Since the plate below each riffle cannot become blanketed, each particle has an opportunity to strike the mercury. A riffle-block $\frac{3}{8}$ inch high, $\frac{1}{4}$ in. wide, and 4 in. from the next one on each side is preferred.

Where there is platinum in the sand, or where the gold is difficult to amalgamate on account of oxide, greasy, or silicious coatings, I use an electrified riffle-block insulated from the plate by means of a strip of wood or other nonconductor. These riffle-blocks are held in similar racks. Salt solution is used to feed the sand over the riffles, and sodium is deposited from this into the mercury by electrolysis. The hydrogen formed at the plate removes oxide coatings. Caustic soda produced from the salt solution by electrolysis removes silica and grease. The 'quick' is always bright and never flours; a 100% extraction is not unusual where the metals are not wholly encased. The electrical efficiency is high on account of the nearness of the anodes to the plate. The cost of extraction when spread over the total yardage is from a fraction of a cent to several cents per yard, exclusive of concentration. The cost of concentration is much reduced because of the low ratio. All freight and smelter charges are done away with and an almost equally high extraction secured with no loss in fume.

The apparatus is inexpensive and simple to operate.

†M. & S. P., May 1, 1915.

It can be installed by any electro-metallurgist after he has familiarized himself with its details. Since the ratio of concentration would hardly ever be less than 40:1, only a limited plate-area is necessary, and the capacity of the plant is dependent only on the amount of material that can be concentrated to the value of $20 per ton in 24 hours. The plate has generally a grade of about three inches per foot, thus reducing the sand-bank formed in front of the riffle-block or anode to the minimum, and reducing the amount of solution necessary to wash the black sand over the plate.

The gold and platinum in the black sand, after passing over the electrified riffle-block (anode), drop nearly straight down to the plate while the lighter black sand strikes the plate somewhat farther down. If the metals are not immediately amalgamated they drag slowly down to the sand bank in front of the next riffle-block where they work underneath the sand through the mechanical action of the solution. At the same time they are thus brought into and held in the zone of electrical action and are soon amalgamated. Most of the metal is caught in the first foot of the plate. Sodium is deposited continuously and has little chance to oxidize in the salt solution. When it is desired to clean-up, the riffle-racks are removed, the amalgam scraped, squeezed, and placed in water for a few hours or until the sodium is oxidized, when platinum will no longer be held. A little fresh mercury is added; this picks up the gold amalgam and leaves the platinum. The usual methods of treatment are then followed.

T. W. Gruetter.

Portland, September 8.

Valuation of Metal Mines

The Editor:

Sir—The results of the valuation of Michigan's mines in 1911 by Mr. J. R. Finlay have come in for criticism as well as praise. The criticism has come mostly from Lake Superior; it has been based partly on the arguments that the numerical factors assumed by Mr. Finlay, such as 5% as the dividend interest and 4% as the rate of amortization, are unfair to the mining companies. Another objection is that, while the system of appraisal is perhaps technically admirable, in practice it discourages exploration and blocking-out of ore in advance, because as soon as additional reserves are proved, the taxes are increased just that much. Mr. E. E. White of Ishpeming prepared a careful criticism of Mr. Finlay's results, to which (as I remember) Mr. Finlay replied rather weakly.

Another vigorous dissenter to increase of iron-mine assessments by the Finlay system has been Mr. Thomas Walters of Ishpeming, for many years Lake Superior agent for Jones & Laughlin. Mr. Walters claimed, with some apparent justice, that the Lake Angeline mine was taxed out of all proportion to its actual value, merely because Mr. Finlay had assumed or guessed that the old mine, which was nearly exhausted, would continue to produce as it had in the past. The Lake Angeline mine was a remarkable money-maker in its day, both on account of richness of the ore and for the reason that under the skillful management of Mr. Walters and his staff, a praiseworthy efficiency was maintained over a long period of years. Because this assessment was based largely on the mine's past record, it was contended in Ishpeming that the State of Michigan was taxing the brains and initiative of the mine-staff. Of course, in refutation of this, it can be pointed out that a man who is taxed on his income or improved property is being penalized likewise for having brains and ability, so that one case is no more unfair than the other. I was in Ishpeming last month, and on the day I arrived, the Lake Angeline mine (which is close to the trim city of Ishpeming and includes scores of dwellings and a large acreage of land) was sold at auction for the ridiculously low sum of $27,000. It seemed as though Mr. Walter's contention, that the famous property had been over-assessed, was proved.

As indicative of the difference between a Michigan mine's assessment by the State Tax Commission and its value for the purpose of re-sale, there is pertinent the case of the Republic iron mine sold two years ago for $600,000 by the Cambria Steel interests to the Cleveland-Cliffs Iron Co. This mine was assessed that same year by the State at $1,040,000, and the next year for $1,110,-299, which is nearly twice the sale-price. In addition to paying only $600,000 for the mine, the deal with the Cleveland-Cliffs Iron Co. included the transfer of 4000 acres of land, and a favorable contract from the Cambria Steel Co. for supplying iron-ore over a long period.

P. B. McDonald.

San Francisco, October 23.

A Curious Nugget

The Editor:

Sir—The enclosed photograph is of a gold nugget shown to me by Mr. Fred. U. Best, in the Canadian Pavilion, last spring. I was so interested that I asked him to let me have a photograph of it. My object in sending it to you is that it may throw some light on the

THE NUGGET.

formation of placer gold. The gold was clean, bright, and free from rock, and, would seem to me, probably to have been formed in place.

The nugget was found by Mr. Best on Bonanza creek, Chisana, Alaska.

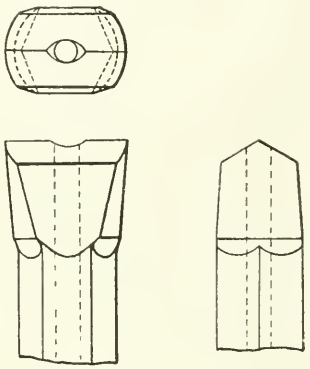
F. H. Mason.

P. P. I. E., San Francisco, September 28.

Rock-Drill Bits

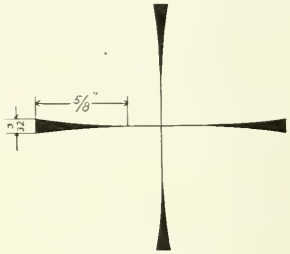
By P. B. McDONALD

Much interest nowadays is manifested in drill-bits. For hard rock, where loss of gauge is a determining factor, the new Carr bit of the Ingersoll-Rand Co. is giving excellent results. The Calumet & Hecla Co. is using this bit extensively with the Leyner-Ingersoll drill, a mounted hammer-machine. Tests have been made by C. R. Forbes and L. M. Cummings in Missouri, to investigate the relative efficiency of piston-drill bits, such as the Z-bit of the southeastern Missouri type, the Joplin 'bull' bit, and the 'flat' cross-bit. By the flat bit is meant a regular cross-bit with edges slightly flattened in proportion to the distance from the centre; a low-centre



THE CARR BIT.

cross-bit is similar to the flat bit, because it soon wears to practically the same shape. The conclusions reached in these tests were: that for piston-drills in granite, long-winged flat bits are very satisfactory; the Z-bit appears to drill especially fast at the start, but loses gauge rapidly; the Simmons bit (a Western bit with one cutting edge advanced, the other being flat and serving as a reaming tool) gave results similar to the Z-bit; an increase of air-pressure from 70 to 85 lb. (about 17%) using a C-110 Ingersoll-Rand butterfly-valve piston-drill in granite with regular bits effected an increase in drilling speed of from 30 to 50%. In one test, using a flat bit, the remarkable distance of 22 ft. was drilled in granite without re-sharpening and at an average speed of nearly 4 inches per minute; this bit wore from $1\frac{3}{4}$-in. gauge to the size of the inch octagon-steel. The generally wider use of bits that will hold their gauge satisfactorily in hard rock, such as the Carr and flat bits, is tending to the practice of drilling longer holes for stoping. In some districts this system of deep drill-holes is reducing costs to a surprising extent. By blasting long holes (say of 12 or 14 ft.) on a large scale, great masses of ore can be broken that, if necessary, can be block-holed by jack-hammers. This system is more efficient than the former method of blasting short holes (say, of 6 ft.). Of course, where the ground is dangerous or irregular, deep holes may be impracticable, but in homogeneous rock the large-scale blasting is apt to be much more efficient. With Carr bits, the reduction in gauge of bits on successive lengths of drill-steel can be as small as $\frac{1}{16}$ inch, which is a factor of tremendous importance in hard rock. There is a tendency to use compressed-air at a higher pressure than formerly for rock-drills, although at some mines this change has come indirectly through utilizing the same



A FLAT CROSS-BIT.

air-plant for smaller modern drills that had been used previously for drills requiring more air. In regard to the proper hardness of drill-steel as indicated by the amount of carbon in the steel, authorities claim that the harder the rock the softer must be the steel, for the reason that the bit will not stand the impact if too-hard steel is used to drill hard ground; this sounds paradoxical at first, but logical enough when carefully considered. The practice of punching a hole in the side of hollow drill-steel for mounted hammer-drills of the Leyner type, an inch or two from the end of the bit, is a common aid to better drilling in soft rock where the bit tends to clog with rock-chippings or mud.

Fuse

The Coast Manufacturing & Supply Co., which manufactures much of the fuse used at Butte, gives the following suggestions as to the proper handling of fuse in blasting.

1. Cut fuse squarely, not slantingly, at the end that goes into the cap. A pointed end is liable to get turned over in warm weather when the fuse is pushed into the cap, resulting in a misfire. Or, in cold weather it is not particularly safe to jab a sharp-pointed hard piece of fuse into a cap.

2. While axle-grease or crude-oil may have some water-proofing qualities if applied to the outside of a fuse, when capped, to make a so-called water-proof joint, grease and oil are solvents of the varnish on the fuse and consequently may destroy the powder-train with as great rapidity as the water which the miner is trying to exclude.

3. Don't use fuse that has been hammered or injured by falling rock, as such injury increases the burning rate; there have been instances when a fuse hammered in this manner burned almost instantaneously.

4. Don't hesitate to cut an inch of fuse from the end; as this will prevent the damp ends from getting in the caps.

Air-Froth Flotation—II

[In our issue of October 16 we gave an excerpt from the speech made by Mr. W. A. Scott, counsel for defendant in the case of Minerals Separation, Limited, *v.* Miami Copper Company. We follow this now with lengthy quotations from the speeches of Messrs. Henry D. Williams and W. Houston Kenyon, of counsel for the complainant. In the first excerpt Mr. Williams discusses the article by the three students at the University of California, as published in the college magazine, *The California Journal of Technology*. The major portion of that article appeared in our issue of July 31, 1915, to which the reader is referred in order to follow the lawyer's remarks. In the second and third excerpts Mr. Kenyon discusses some of the physics of the flotation process. Of course, the reader must remember that this exposition of the subject, like that of Mr. Scott, is not to be taken as a scientific thesis; it is essentially an *ex parte* explanation, but even as such it is extremely interesting to metallurgists. The first patent in suit, to which reference is made, is No. 835,120.—EDITOR.]

MR. WILLIAMS: *The California Journal of Technology* is evidence of the interest that the metallurgical world took in the Elmore process. The title is 'Experiments on the Elmore Process of Oil Concentration.' The conclusion is:

"The work above outlined suggests many lines of further investigation, and as these come to be worked out, the process will become more valuable and of more general application."

What process? The Elmore process.

In 1903, the Elmore process was a hope of the metallurgical world.

Incidentally, the students discovered something else, and, for the first time, gave to the world the foam effect. Full disclosure as to a mode of operation which would produce an oil foam, they, for the first time, in the history of metallurgy, gave to the world.

That was an incident of their careful investigation, but the article itself is on the Elmore process, and it says that the Elmore process was then a hope of the metallurgical world.

THE COURT: Mr. Williams, if there was a disclosure of the process, although a misnomer, what would be the effect of that disclosure?

MR. WILLIAMS: The name, obviously, has nothing to do with it.

THE COURT: No.

MR. WILLIAMS: I was particularly directing my attention to the fact that Mr. Sheridan took those last three lines as something which was directed solely and wholly to that small part of this article which deals with the foam effect.

THE COURT: Oh, I understand.

MR. WILLIAMS: And I was merely pointing to the fact that those lines must have referred to this Elmore process as a hope of the metallurgical world.

The foam effect here disclosed, which is recommended as employing 8.9% of oil—it being clearly shown that nothing else is worth anything—8.9% of oil and salt solution, an ore containing light flaky minerals, such as molybdenite; and another one of the same kind is graphite, and I do not know any others—certainly not copper, certainly not zinc. Galena and blende are not flaky. Galena is almost cubical in its fracture. They call attention to the study of the fracture of minerals. They have worked out this foam effect, which they give to the world, with the recommendation that 8.9% of oil be used, as something which may possibly be useful with light, flaky minerals, and that became a part of the constructive knowledge of the world in November 1903.

It is remarkable that it was buried and lost, and that it took three years of litigation to unearth it. That is quite remarkable, especially that it should have been buried and lost in the University of California, which is in the heart or the centre of the important mining interests on the Pacific Coast, and in the Great West.

But that is all there is there, and the most significant thing about it is that it tells the investigator: We have tried 2.1%, and the result is hopeless. We have tried 5.3%, and the result is almost as bad. But we have tried 8.9%, and there is some hope in that. Now, proceed; investigate.

But very evidently, nobody proceeded and investigated. There is not any practical art, unless it be Elmore. There was not any mill that made any use of any of these patents that have been referred to. Haynes lightly touched upon; Everson, the foundation of the defendant's case—why these very students in this article tell the exact truth about Everson. I am sorry they did not write more, because they would have been impartial, and they would have possibly given us a fair, unbiased interpretation of the patent.

"In 1886 Carrie J. Everson of Chicago* contributed the idea that the concentration was aided by the presence of an acid solution, and patented the same."

That is just exactly what Carrie Everson did contribute. It is an exact statement, and that is preceded by reference to another patent, which the defendant has not seen fit to refer to, although it has figured in some of the other litigation—the patent of Tunbridge, erroneously here spelled as 'Turnbridge.' That is set forth here as the first patent for utilizing oil, and its date is given as 1878. But it is of slight relevancy, and the defendant has not relied upon it, and it is, as your Honor will note, later than Haynes.

*In her first Patent, No. 349,157, she is described as "of Chicago, Illinois" but in No. 471,174 she is said to be "of Denver, Colorado."—EDITOR.

As a matter of fact, the reference to this patent would indicate a study of the Everson patent, because the Everson patent disclaims the Tunbridge patent. It does so with quite some labor. It is the thing that Carrie Everson had to distinguish from; that I think accounts for the reference to that patent.

These students probably investigated the patent situation, and so they referred to the Tunbridge patent and the Everson patent, and they tell the exact truth of the contribution of Carrie J. Everson to the art of the idea that the concentration was aided by the presence of an acid solution.

Then these young men say, and they say truthfully:

"But the absence of a successful method of separating the mineral from the oil prevented the practical application of these prior patents."

Well, they do not tell the whole truth about that, but that is undoubtedly one of the reasons, and the important thing is that these prior patents, Tunbridge and Everson, were not practically applied. That they were not capable of practicable application would be the reasonable presumption, but that is the fact. And then these students go into the subject of the removal of the oil. Of course, with 17.1% of oil, which is 342 pounds of oil to the ton of ore, and if out of the ton of ore you got 700 lb. of concentrate, that would be a fair average. With these 342 lb. of oil, you see the oil would be about 50% of the concentrate. You would have a great mass of oil with the concentrate, and unless you could successfully get rid of that oil, it would be troublesome; and, again, the cost of that oil was such that it must be possible to recover and use it over again. It has acted merely in a physical manner. It has not changed its constitution at all. So, if you could bring it out, separate it, and send it through again, there was some hope; it was Elmore who did that.

The students say that burning of the oil was tried, which left a difficult residue to treat, and the large consumption of the oil made the method too expensive. That is undoubtedly true.

"It was not until July 1900 that this difficulty was overcome by means of a special machine, similar in most respects to that which is used in sugar factories and in milk and cream separation. This contribution by Mr. Elmore then made the process feasible."

Now, we will note here that they mean the process of oil concentration. These young men were looking at it solely from the viewpoint of something which utilized oil in the concentration of ores—they were not concerned particularly with methods, but they were looking at it always from that viewpoint; that is why they refer to Tunbridge, and why they refer to Everson, but there is not a thought or suggestion running through here that the Everson patent, which they say has proved of no practical value, makes any suggestion of flotation. Everson merely contributed the use of acid.

Mr. Williams: Prior to the invention of the first patent in suit, and looking only to what men did, we find that wet-concentration processes were the solution of the ore-concentration problem. They were the processes that have been described here, and that I need not describe again; processes that depend upon gravity and shaking and motion of finely ground ore suspended in moving water, the separation depending upon the difference in sinking-power of the metal and the gangue; wet-concentration processes that are in use to a tremendous extent still, but that are being superseded in the last two or three years to an astonishing degree by the processes of the patents in suit.

Now, in these wet-concentration processes advantage was taken of the fact that the metal had a higher specific gravity in the average than the gangue, and the laws of nature were followed. The heavier thing was allowed to settle, and circumstances and conditions were so controlled that it would have a chance to settle away while the gangue would be left suspended. The gangue would be floated in mid-bulk of the liquid, and up and down and all around, and finally floated off over a dam.

But all wet-concentration processes—and the machinery for carrying them out has exercised the ingenuity of inventors for thirty years—all wet-concentration processes were useless on slime, and the fact that the concentration was by such processes raised a hard and fast limitation to the extent that you could grind your ore. The grinding must be coarse. The grinding must be so done as to produce the minimum of metal-dust; and so grinding machines were invented to that end, to prevent the production of the fine dust-like particles of metal in the general grinding of the ore. All wet-concentration processes are useless on slimes. They will not settle. They will not obey the laws of gravity. They will stay up with the gangue. They will float off with the gangue. They will run to waste. And hence we have these tailings in Australia and here, of millions of tons, where the slimed metal, the finest of the metal, has all run off, because it could not be recovered. With such concentration processes the best that could be done was from 60 to 70% recovery. Prof. Fulton gave 70% as the outside limit—60 or 70% of the sulphide metal in the original ore. And yet men persisted in using that process.

Elmore, about the opening of this century, about 1900—his patents were a year or two earlier—came in with his process to reverse the laws of nature. Instead of finding the heavier thing at the bottom, Elmore said: "I will carry it to the top."

Again a process useless on slime. Again a process requiring coarse grinding as before. The concentrate at the top now instead of at the bottom. The theory of operation was an oil lake. I like that word 'lake.' It is used by the *California Journal* students—an oil lake. Air entrainment was fatal. Ingenuity was exercised to so mix the oil lake and the ore as not to entrap air. Oil-emulsion was fatal. The amount of oil we know was 100 to 300% on the ore. And yet men did that thing. Men paid that price, and the loss on every 100 lb. of oil was 9 or 10 lb. at each cycle. The other 90 lb. had to be taken out, and preserved, and used over again.

And Cattermole. The very men who afterward made the invention of the first patent in suit, spent two years and a half developing that Cattermole process, a really

beautiful idea, the first process addressed to the slime problem. Said Cattermole to himself:

"Now, if I can have fine grinding of the gangue and coarse grinding of the metal, I can separate the metal out by its dropping and by the gangue floating." For right there is an interesting principle of physics. When a particle is floating in water, its tendency to sink is determined partly by its weight. The weight tends to carry it down if it is heavier than water. The surface of the particle tends to resist that, tends to keep it up. If the surface is greater, in respect to the weight, it will not go down so fast. If the weight is greater in respect to the surface, it will go down faster. Now, if you imagine a little cube of metal suspended in water, and imagine its linear dimensions doubled in all directions, the surface will have been squared, and that is the thing which resists dropping, while the weight will have been cubed. The weight has increased faster than the surface. Therefore that doubled cube will sink faster through water. That law, of the square as to the surface, resisting sinking, and the cube as to the weight compelling sinking, is the thing that makes big particles drop more in accordance with their true specific gravity, but fine particles like slimes refuse to obey the laws of specific gravity, and continue to float and not sink, whether they be mineral or whether they be metal.

As Dr. Liebmann illustrated on the stand, if the rain came down in a shaft it would kill us all. When the same amount of rain is broken into small drops, it does not kill us. Why? Because the surface has been so enormously increased with respect to the weight, or vice versa the weight diminished with respect to the surface. So the resisting surface makes those drops come down, not like bullets, but gently. And going a step further, when the particles are smaller still, they will not come down at all. They will float like the summer cloud in the sky. Their specific gravity is just as great as it ever was with respect to the air, but they are so small that they are floated.

THE COURT: Is it because they are so small, or is it because of their form?

MR. KENYON: Their form would have a tendency to be spherical in all cases, but it is a function of their size.

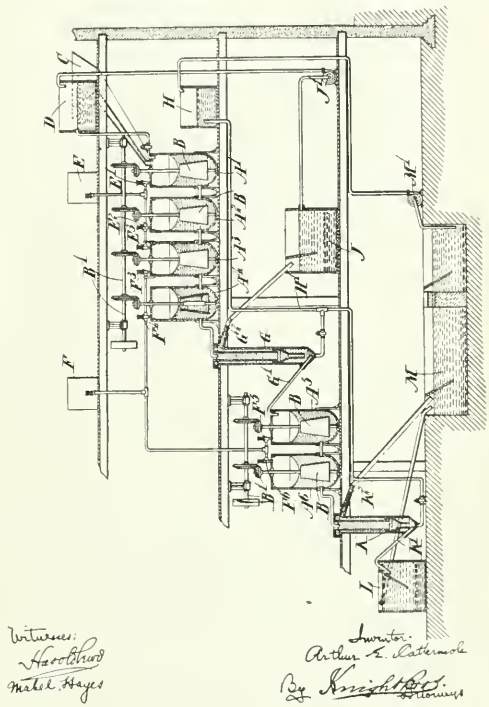
THE COURT: I suppose if you dropped a needle into water and kept it point downward, it would go down fast.

MR. KENYON: Yes, it would go right down. Drop it sidewise, so that you have multiplied the surface without changing the weight, and it will stay right there.

Now, Cattermole conceived this brilliant idea: If I can only make my gangue particles fine, they will stay up there indefinitely. If I can only make my metal particles big, they will drop faster. He knew he could not do that in grinding. Let the inventor of the future, if he be here present, take this for a cue: A grinding machine that at the same time will grind the gangue fine and the metal coarse will revolutionize all these processes. Cattermole knew that could not be done in grinding, so he said: "I will grind it all fine, and then by the gluing effect of oil, particle to particle, oil which goes to metal and does not go to gangue, I will roll and work my metal particles into big metal particles, whereas the gangue will remain as fine as it was ground; and then when I have done that, my big metal particles, my granules, my spherules, will drop and the gangue will go up."

That was the Cattermole idea, and men proposed to do that thing, and these plaintiffs, and the world would have been concentrating their ore by that process today in preference to all others, probably, but that the invention of the first patent in suit was made.

The Cattermole idea of operation was by oil adhesive-



CATTERMOLE'S PATENT.

Reduced facsimile of drawing accompanying A. E. Cattermole's patent, No. 777,273, of December 13, 1904.

ness and mixing. Air entrainment was a trouble. Flotation scum was a loss. Two to five per cent of oil on the ore (4 to 10% on the metal; it was a rich 50% metal ore) was the amount, and if the effects were diminishing, then they increased slightly the amount of oil. (Higgins, Printed Record, p. 212. Q. 43, 44.)

Thereupon a recess was taken until two o'clock p.m. same day.

THE COURT: Mr. Kenyon, I was very much interested in the remark you were making before recess on the matter of the difference between big particles and little particles, in the strength of their power to overcome resistance. Now, entirely aside from surface tension as such, and I mean that sort of tension to enable very minute particles, although having a greater specific gravity than other particles, to float on the surface.

Aside from that, and aside from the case in which the mineral particles having greater specific gravity are attached to any medium of buoyant character which tends to support them, these small particles, if once placed beneath the surface of the water, having greater specific gravity, of course, would sink.

Mr. Kenyon: Yes, and No. The coarsest will sink at once. The finest of them would ultimately sink, but the finest of them would take so long to sink that it is impracticable to separate them or do anything with them by sinking, and that was the slimes problem in all these metallurgical operations. They would float there. They would float in the liquid. When you get down to a certain ultimate point of fineness, whether it be metal or gangue, it will float in the water underneath the surface.

The Court: Underneath the surface?

Mr. Kenyon: Underneath the surface.

The Court: But still they would gradually sink?

Mr. Kenyon: After a long, long time.

The Court: I would like to understand you. Of course, we all know that if we could conceive of a perfect vacuum, both a bullet and a feather will go down together.

Mr. Kenyon: Under the law of their specific gravity absolutely.

The Court: When you come, however, to a resisting medium (I do not care whether it is air or water) then you have a different proposition, and there you have a resistance which has to be overcome, and as you proceed arithmetically the resistance increases geometrically, I believe. Is that right?

Mr. Kenyon: Yes.

The Court: My question is whether these particles would finally sink? I want to get the theory if I can. Aside from surface tension, if you once get those particles underneath the surface of the water, not attached to any bubble or any substance which has a less specific gravity than water, will they not sink, although at a greatly diminished rate?

Mr. Kenyon: It will ultimately sink, although there may be what they call a colloidal condition, which has been somewhat discussed here—clays are very colloidal, and have a tendency to keep them in suspension perhaps for days before they would sink. Even they will, as I understand it, ultimately sink.

The Court: Ultimately?

Mr. Kenyon: The least little jar or agitation will send them right up again. The whole slime problem and difficulty in all metallurgical operations, and in the cyaniding processes as well as concentration processes, turn just on the long length of time it takes the fine particles to settle to the bottom. They will float an inch below, two inches below, three inches below, all around, almost indefinitely, making muddy water.

The Court: The very instant this material passes into a larger mesh and you have a larger particle, it will overcome that resistance?

Mr. Kenyon: Yes, sir, and then the weight increases by the cube, whereas the resistance only increases by the square.

The Court: I see.

Mr. Kenyon: That is the mathematical theory of the whole thing. So, the coarser the grinding the better these water separation processes were, the greater the difference in specific gravity. But what you ran up against there was the fact that in the heart of a grain of gangue there might be a particle of metal, and you have lost it by not grinding fine. So there the millers were between the Devil and the deep sea.

Mr. Kenyon: It has been shown that the processes of the patents in suit depend in part at least upon certain simple facts of physical science that are observable to the knowing eye, and that clearly distinguish them from the prior art. We have shown that these processes are not oil-foam or oil-froth processes, or oil-emulsion processes, or aerated oil-flotation processes in any proper sense, but are processes of air-flotation: processes that effectively evoke the power of air to select out the metal from the gangue in a freely flowing pulp, and to float it to and through the surface for separation.

Air has little affinity for oil as such, and air-bubbles do not readily attach themselves to oil globules, and have slight lifting power when so attached. If a particle of mineral lies entrapped in an oil globule, or has an oil globule attached to it, an air bubble coming in contact with the oil globule will take away a portion of the oil, but will have little tendency to attach itself to the mineral. Therefore, while air bubbles may be mechanically caught and entrapped in oil, and may in that way increase and greatly increase the mass buoyancy of the oil, that is, its power to raise mineral particles that are also caught and entrapped within it, this action of the air (which had been suggested in the oil-foam processes of the prior art) is not secured unless the amount of oil is sufficient and the character of oil suitable to so mechanically embrace and entrap both air and mineral. That is, the oil must be viscous.

Air has a powerful affinity for clean, metallic, sulphide surfaces. This affinity is defeated for all practical ore concentration purposes in the mill when the mineral surfaces are coated with so much oil as to exhibit the physical properties of oil as such, such as adhesion to other similar oiled mineral surfaces, as in the Cattermole process, or adherence to an oil lake or to an oil foam mass and resultant buoyancy flotation, as in the Elmore process, the *California Journal* process, and so forth. But when the film of oil on the metallic surfaces is extremely attenuated (as when 1% of oil to ore is employed) the affinity of air for metal is not merely undefeated; it seems to be positively increased (why, we do not know) so that for all practical ore concentration purposes in the mill the attachment of air to such metal when once attained will persist in and out of the pulp, and will survive any amount of excess agitation or of excess aeration in the pulp.

Air bubbles have vastly greater lifting power for metal particles than oil globules have, and especially the sort of air bubbles that are produced, either by agitation or

by aeration, in water modified by the reagents of the patents in suit.

Air bubbles in unmodified water, however produced, progressively and rapidly coalesce, and with explosive violence, which tends to explain the fact that such air bubbles, namely in unmodified water, will not practically concentrate ore.

Air bubbles in pulp modified by the re-agents of the patents in suit have an enhanced selective affinity for metal over gangue (why, we do not know), and a persistence of life as bubbles in the pulp and a persistence of attachment to contacting metal particles in and out of the pulp sufficient (but why, again, we do not know) to permit in practice of ready separation and removal, and to result thereby in effective ore construction.

THE COURT: You say "Why, we do not know." Is there any theory on that subject?

MR. KENYON: We have presented no theory.

THE COURT: You have no theory?

MR. KENYON: We have no theory. Dr. Sadtler says variation of surface tension explains the phenomenon, but how I do not know. I do not know how variation of surface tension can enhance selective affinity, or how it can explain persistence of life as bubbles in and out of the pulp, or how it can explain persistence of attachment to contacting metal particles in and out of the pulp, to such a degree that practical ore concentration in a mill is an accomplished fact.

Whatever the explanation of the phenomena involved, it is clear that the operation proceeds by contact of air and metal in a freely flowing pulp under circumstances conditioned by the presence of the re-agents of the patents in suit, and opportunity of flotation after contact.

THE COURT: You say the contact between the air and the mineral particles?

MR. KENYON: In the pulp.

THE COURT: Now, if the mineral particle has a film of oil, no matter how thin, how is there any actual physical contact between the air and that particle?

MR. KENYON: The mystery of the thing is that when the oil film of the attenuated character that is produced with one-tenth of 1% of oil to the ore, when that film is present on the metal particle, the air particle has an enhanced appetite for it, seeks it with increased avidity, instead of with diminished or defeated avidity such as a thicker film will produce.

THE COURT: And it seeks it through that very thin film?

MR. KENYON: Seeks it through that very thin film, as it were—that helps.

THE COURT: Not through the actual contact, but through the film being so very attenuated, it seeks the metal particle, and the interposition of the film, far from lessening the selective action of the air for the metal, enhances it—is that right?

MR. KENYON: Yes, that is right, and Dr. Sadtler on the stand suggested an idea that may help a little. He said that an attenuated film of that kind might possibly be conceived of as smoothing the roughness of the surface of cleavage of the sulphide particles.

MR. WILLIAMS: That was Dr. Liebmann.

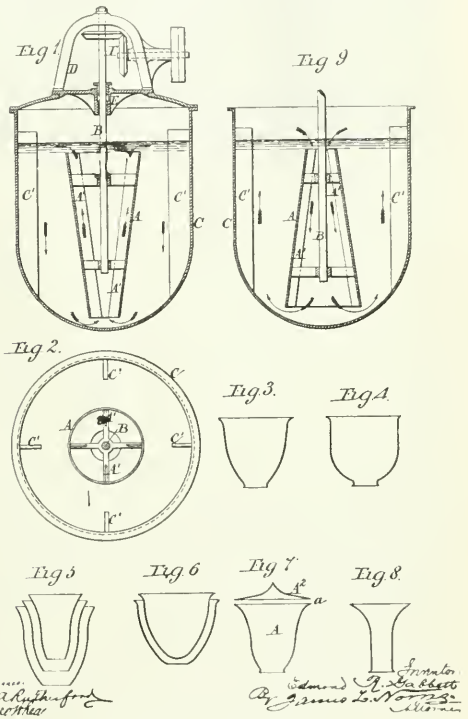
MR. KENYON: Dr. Liebmann?

THE COURT: Increasing the effect?

MR. KENYON: Increasing the attachment or appetite of the air bubble for that surface so smoothed.

MR. WILLIAMS: In fact, they both suggested it.

MR. KENYON: Yes, Dr. Liebmann also suggested that idea; and Mr. Dosenbach, as I remember, said that when these particles had rough surfaces the air bubble would not hold them. It is the smooth surface that the air



THE GABBETT MIXER.

Reduced facsimile of drawing in E. R. Gabbett's patent, No. 444,345, of January 6, 1891.

bubble gets its grip on. Now, this microscopic film of oil may fill up microscopic cavities, may bridge over microscopic roughnesses, may make smooth what was before rough, and in that way enhance the avidity of the air particle for it, and the grip of the air particle upon it; but I present that with diffidence. That is a matter of speculation.

THE COURT: You have the evidence on both sides for that, so I do not suppose counsel on either side will contest it.

MR. KENYON: That is so, but with all respect to both witnesses, I present the suggestion with diffidence.

But now let me state again what are the clear essentials from the point of view of operation, whatever the explanation of phenomena. Whatever the explanation of the phenomena involved, it is clear that the operation

proceeds by the contact of air and metal in a freely flowing pulp under circumstances conditioned by the presence of the reagents of the patents in suit, and opportunity of flotation after contact. You have got to bring your bubble and your metal particle into contact in this freely flowing pulp, and under circumstances conditioned by the presence of the reagents of the patents in suit. But to have brought them into contact—that is not enough. There must be another factor, namely, opportunity of flotation after contact, so that you may separate—flotation up in the pulp and through the surface of the pulp—so that you may practically separate them.

THE COURT: Those are essentials in the flotation.

MR. KENYON: Those are the *sine qua nons,* and those are the only *sine qua nons* if we have presented the proper theory of operation.

And as to apparatus, it is clear, too, that apparatus for efficiently bringing about in a freely flowing pulp the contact of air and metal under the conditions stated, and for permitting or assisting flotation after contact, is all that is required.

It has been shown not only that the fine and slime that were practically unconcentratable in the prior art, except perhaps by Cattermole—I say 'perhaps' because Cattermole never reached the mill. On the threshold of the mill the life of the Cattermole process was cut off by this greater child of the brains of Sulman, Picard, and Ballot.

It has been shown not only that the fine and slime that were practically unconcentratable in the prior art (except perhaps by Cattermole) can be successfully concentrated by the processes in suit, but also that the presence of such fine and slime in the pulp actually assists the concentration of the ore, and is indeed almost essential to practical success; so much so that the art of grinding has been revolutionized where the processes in suit are employed and fine grinding has become the rule, where before it would have been the ruin, of the mill.

The history of what happened in the practical art before the inventions in suit were made, and of what has happened in the practical art since that time, shows that while ways and means of bringing about contact of air and metal in the pulp and of permitting or assisting flotation after contact may be widely varied, the success of the process is sharply conditioned within relatively narrow limits in the matter of the quantity of reagent employed, when that reagent is the oil of the first patent. Especially is this true and crucial in the case of the first patent in suit, since it has been demonstrated beyond dispute that any notable increases of oil above the minute proportion there specified practically defeats the end in view and would in the mill practically prevent the concentration desired, and would be, not only intolerable, as a dirty and utterly non-controllable mill operation, but impossible, as giving at greatly enhanced cost a greatly depleted and inferior product.

Now, why the bubbles have enhanced selective affinity for metal over gangue, and why they have enhanced persistence of life as bubbles in and out of the pulp, no one really knows. No one really understands today why the process works as it does work. Under such circumstances prevision was impossible. And where prevision is impossible, nothing can anticipate except the very thing.

THE COURT: That would indicate that this was a discovery rather than an invention of a process.

MR. KENYON: Yes. It started with a discovery. As a process it became an invention.

Ore-Treatment in Korea

The report of the Oriental Consolidated Mining Co. for the year ended June 30, 1915, is just to hand, and contains the following information on the operation of its mills and cyanide-plants:

Mill.	Stamps.	Ore crushed.	Concentrate saved.	Bullion from ore.
Tabowie	80	117,928	13,719	$407,395
Taracol	80	135,732	12,108	302,319
Kuk San Dong	40	12,790	1,316	27,988
Maibong	40*	26,330	925	210,305
East Candlestick	10	5,109	5,109	33,740
Total	250	297,889	33,177	$981,747

*Part of time.

The average stamp-duty over 230 days was 4.456 tons. The ore assayed $6.55 per ton, and about 50% was recovered in the mills. The concentrate was valued at $780,740, of which $643,571 was extracted as follows:

The Taracol cyanide-plant treated 26,037 tons (including 210 tons of dump re-treatment), with 83.9% recovery, an increase of 1.4%, but at 14c. per ton higher cost; Kuk San Dong, 1398 tons with 54.2%; Kuk San Dong re-treatment, 2837 tons with 73.3%; Candlestick, 5109 tons with 52.5%; and Maibong tube-mill plant (completed late in January), 800 tons with 73.9%, but an average of 88% is expected.

Milling cost 48c. and concentrate 21c. per ton of ore treated ($1.88 per ton of concentrate treated.) The total extraction was 90.3%.

Improvements and re-construction of plants amounted to $140,037.

Dredging in Australia

In Victoria, during 1914, the total quantity of material treated by 45 dredges and 40 hydraulicking plants was 13,979,696 cu. yd., against 16,796,585 yd. in 1913. The gold saved was 56,796 oz., against 65,433 oz. in 1913. The yield per yard was 3.8c., the same as in the previous year. The total area treated was 459.3 acres, the ground varying in depth from 8 to 70 ft. The number of men employed was 1016. Dividends paid amounted to $160,000. Wages and other expenses amounted to about $850,000. The first cost of the plants was approximately $1,570,000. The quantity of tin saved during the year was 45 tons. Satisfactory work in the settling of sludge and stacking of tailing has been carried on throughout the year. In the Bendigo district complaints were investigated where tailing had accumulated in certain water-courses. Wind had blown the tailing, and rain washed it into the water-courses.

TROJAN MILL.

TAILING DAM.

Trojan Ore and Milling Practice

By JESSE SIMMONS

Cyanidation at the plant of the Trojan Mining Co., in the Black Hills of South Dakota does not present any particularly novel features, but the observer will note some refinements and labor-saving devices worthy of mention. The process consists of crushing in cyanide solution in a Chilean mill, the product being divided into 45% sand and 55% slime in classifiers. The sand is given a simple leaching; the slime is reduced to 55% moisture in a thickener, then, after 12 hours of agitation in conical-bottom tanks it receives final treatment in a filter.

MILL-FEED. This consists of that type of auriferous material from the Cambrian measures that has been so happily described as "refractory silicious"*. It is of three general classes, (1) a replaced dolomitic rock of fine texture, (2) a mineralized quartzite, and (3) material from the 'verticals' or mineral-filled fissures and fractures, together with some of the enriched wall-rocks.

It is probable that the gold was originally in combination, in at least a portion of the ore, as sylvanite or a sulpho-telluride; this is indicated by occasional showings of sylvanite in the unoxidized ore deposited on the quartzite. The sylvanite is not, however, of sufficient frequency to form a firm foundation on which to build an indisputable hypothesis; it is to be regarded merely as a suggestion. Pyrite is found throughout this unoxidized ore, all of which, by the way, is shipped to smelters when its gold content is sufficient to bear the expense; otherwise it is left in the mine, since in the cyanide-mill only one-quarter to one-third of the gold is recoverable.

The oxidized ore shows little, if any, pyrite or other metallic mineral, and no free gold can be found by panning. Still there are indications that the gold exists in the native state in an extremely minute, or micro-

*Professional Paper No. 26, U. S. G. S.

COTTAGES FOR EMPLOYEES.

THE JUNCTION.

scopic, form. Probably the fact that over 80% of the recoverable gold is dissolved with ease—entering the solution before the pulp leaves the Chilean mill—is due to its being in almost molecular particles. In contradiction to this theory, the fact is mentioned that amalgamation fails to recover any gold. Still this may not be conclusive; the gold may be so fine, or so coated with oxides of iron, tellurium, or selenium—or all three—that it is not amalgamable.

Evidence suggests that the gold-bearing solutions followed the crevices and fractures until they encountered a stratum of limestone or lime-shale, either of which may have formed an active precipitant. Silica and gold-bearing minerals replaced the alkaline carbonates to form the orebodies. Study of thin sections under the microscope bears out the geologic features exhibited underground. These verticals cut through strata of mud-shale, sandstones, and sand-shale, and sheets of porphyry, for considerable distances, leaving only vague traces of their enriching agency, but, encountering a limy rock, workable ore deposits have been formed.

In general these verticals, or at least the strongest and most persistent, have a north-south course. Others, not so long, strike in various directions. Between the quartzite, or basal member of the Cambrian, which lies unconformably upon the Algonkian schist, and the 'upper ore contact' is a perpendicular distance of fully 500 ft. Verticals of similar characteristics—alike in appearance, composition, strike, etc.,—are found at both horizons. It is readily conceivable that they are of the same series and that development will prove them continuous through the intervening strata. Whether orebodies will be found in this partly developed area would seem to depend mainly upon the existence of strata of limy rock that could have been enriched by the mineralizing solutions. The fact that the verticals do not continue downward into the schist, although they extend upward through the sedimentaries for hundreds of feet, may be construed as evidence of a downward or lateral circulation of the mineralizing solutions.

Porphyritic rocks, presumably of Tertiary age, including rhyolite, trachyte, andesite, and phonolite, have had a bearing undoubtedly upon the formation of the ore. Their coming was accompanied by faulting and breaking of the strata; then also probably the fractures, later to be filled with silicious materials, were formed. It is noted that on the quartzite in the neighborhood of vertical displacements good bodies of ore often are found.

Crusher and Ore-Bins. An ingenious arrangement of three ore-bins with a total capacity of 1000 tons permits all of the ore to be drawn direct over grizzlies spaced at $1\frac{3}{4}$ in. to a No. 5 K Gates crusher, set to crush to $1\frac{3}{4}$-in. These bins are on the side-hill at the rear of the mill, giving them and the crusher a secure foundation. The face of the rear bin is parallel with the slope of the hill; in front are two bins at right angles to it. At the bottom the fronts join to leave a rectangular space about 10 by 12 ft., in the centre of which the crusher is set. The product of the crusher, uniting with the ore that drops through the grizzlies, passes direct to a belt-conveyor and is delivered to the mill-bin. This belt is 110 ft. between centres and carries its load up a 16° incline. The run-of-mine ore contains a large proportion of material fine enough to pass through the grizzlies; the result is that when a gate is opened to draw rock to the crusher the belt is over-loaded until the mass of fine stuff is carried away, after which it easily handles the crushed product. A feeder is to be installed immediately to give the belt a more uniform load. It is believed that this improvement will make it possible to secure a life for the belts considerably above the 70,000 tons they now ordinarily handle. It should make it possible also to secure a more accurate sample at the head of the belt, for at the present time it is probable that the automatic sampler, which deflects the stream discharging from the belt once in $1\frac{1}{2}$ minutes, must fail frequently to secure a fair average of the rush of fine, which, while it amounts probably to 25% of the total ore passing over the belt, consumes but 15 to 20 seconds in discharging from the belt.

Sampling. Against the stream of ore discharging from the belt a sheet-steel baffle is mechanically interposed at intervals of $1\frac{1}{2}$ minutes. This directs the stream for a period of a little more than a second into a chute leading to two sample-bins, each of which has a capacity for the entire amount taken during a day's run. In the evening when the crusher is idle the sample is drawn from its bin over a $\frac{1}{2}$-in. grizzly to a No. 2 Samson jaw-crusher, set to crush to a size corresponding with the grizzly-openings. The fine (through the grizzly) and the crushed products drop to an elevator and are taken to a second bin, in passing to which one-half of the ore is rejected by splitting the stream. The reject drops to the mill-bin. After the entire sample is crushed the grizzly is changed to $\frac{3}{8}$-in., the jaws of the crusher are set to correspond, and the sample is run through the crusher and elevator back to the same bin. This process is continued without changing the grizzly or crusher-opening, until the sample is finally reduced to 100 lb. It is then shoveled over a split-sampler, reduced to a few pounds, dried, and handled in the usual manner. The first sample, taken at the head of the conveyor, contains approximately 2% of the total ore carried by the belt. The mechanical cutting-down of this quantity should give a precise composite of the day's run of the plant, when the feeder is installed to load the belt more evenly. At the present time the automatic sample is low in assay-value, compared with the exact sample it is possible to get, that is, a sample taken at 5-minute intervals throughout the whole 24 hours, across the chute that carries the feed to the Chilean mill. This indicates that the automatic sample fails to secure a correct proportion of the fine—a material higher in assay-value than the coarse hard rock.

Chilean Mill Practice. From the mill-bin the ore passes to a shaking feeder and is spouted, with three to four times its volume of mill-solution, to a 7-ft. Trent Monadnock Chilean mill. Two of these are installed, but as one is sufficient to perform the required duty, the second is kept in reserve, fully repaired and equipped,

for an emergency. These mills run at 31½ r.p.m., about 7 revolutions faster than the manufacturer specifies, but they show no strains, and operate as satisfactorily as could possibly be wished.

However, some changes have been made in construction; for instance, there has been inserted a lock-nut holding the gear against a collar on the vertical drive-shaft and eliminating the wearing-rings. Babbitt is used in recesses cut for it in the step-bearing, doing away with the friction of iron against iron. Down-thrust troubles have been minimized by dressing the bottom of the vertical shaft to a convex form and inserting, in the bottom bearing, a steel 'button,' likewise having a convex surface, upon which the shaft rests. These changes have done away with a great deal of side sway, lost motion, and trouble with keys, key-seats, and wearing rings.

Each mill is driven by a belt direct from a 75-hp. old type Bullock motor; the motor-pulleys are 20 in., and the pulleys on the mills 110 in. diam. This is a change from the previous practice of driving from a line-shaft, and is much more efficient and less troublesome. It is interesting to note that these 75-hp. motors are developing 107 hp. and carrying practically 50% overload with perfect ease.

Unquestionably the most remarkable feature of these mills is their capacity, which is probably not equalled, and surely not exceeded, anywhere. It is the practice to put through one of these Chileans an average of 230 tons daily. A 'rektang' screen with an opening of 0.021 inch is used, giving a product that is 55% slime. This may be considered a remarkably high duty, as the ore cannot be designated soft; still it would not properly be classed as extremely hard material. It is a large day's work.

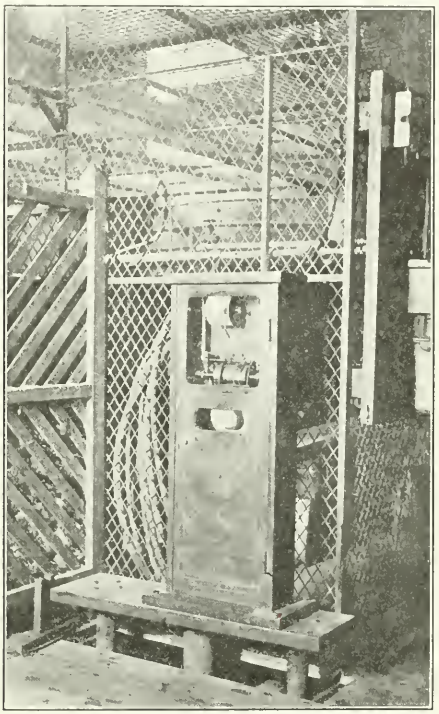
The mills have 4 mullers, each of which when equipped with a new tire, weighs 9000 lb. Tires and dies are made of chrome-steel. Tires crush 26,000 tons before being discarded. Dies weigh, complete, 3400 lb. and have a crushing-duty of 13,000 tons. The thickness of dies and tires is so arranged that a new set of tires will be discarded when the second die is worn out. This reduces to practically a minimum the time necessarily lost for repairs. Beneath the dies are placed 2-in. wooden blocks, raising the die that much above the mortar, and giving a greater screen-area when the die wears thin. This seemingly simple detail makes a decided increase in the efficiency of a mill, and is particularly apparent when the die is worn to 1½ or 1 in. thick.

From the Chilean mills the pulp passes by launder to a bucket-elevator, 37 ft. between centres. The boot of this elevator is of concrete and the housing is sheet-steel. The belt is 18 in. wide: the buckets are 18 in. wide by 6 in. high, of standard pattern.

The elevator discharges into two Dorr duplex classifiers, which divide the pulp into 55% slime and 45% sand. The sand is leached in 6 circular tanks, 28 by 8 ft. The slime flows to a Dorr thickener, operating in a 40 by 14-ft. tank, where the moisture content is reduced to 55%. Part of the effluent solution is precipitated and the remainder pumped to the mill storage-tanks. The underflow from the thickener goes by launder to the agitators—three in number, 17½ by 16 ft., with 30° conical bottoms. After 12 hours' agitation it is washed in a filter and discharged as tailing carrying 9c. of dissolved gold per ton.

The mill-feed averages $4 in gold and 1 oz. silver, per ton. Of the former 75%, and of the latter 35%, is saved. The cost of milling is within a cent or two of $1 per ton.

Future Plans. These include the installation of



SOLUTION METER.

tube-mills for fine grinding, and the raising of the capacity to 500 tons or more daily. This will necessitate a radical change in the cyanide treatment. Sand-leaching will be abolished. The slime will probably first be dewatered in Dorr thickeners, then agitated, diluted with barren solution, thickened, again agitated, thickened, dewatered on a revolving drum-filter to 25% moisture and stacked on the dump. It has been decided also to install for experimental purposes a Holt-Dern chloridizing roaster, with which tests will be made on the blue unoxidized ore. It has been demonstrated that roasting will increase the susceptibility of these ores to cyanidation, but whether this particular kind of a roast will fill the requirements is not known.

Secondary Precipitation. Not the least interesting feature of the property is the tailing-dam and plant, where seepage from the dam is passed through a pre-

cipitating medium. The dam is formed of sand-tailing, which, sluiced from the treatment-tanks, is carried down the gulch in a 6-in. pipe. This pipe has been extended across the gulch, allowing the sand to form an embankment, fully 75 ft. high, that serves to impound the slime. Surface-water is caught above the dam and carried around it in ditches.

A bedrock drain, constructed of concrete, collects the seepage; this is conveyed to the precipitation-house, where are installed 55 tubs, made of whiskey-barrels. After experimentation with charcoal, zinc, and soft-coal clinker, the last was adopted as best suited to the purpose. It is obtained from the Chicago & North-Western Railroad. The idea is to clean the tubs annually and ship the clinker with the slag, matte, and other valuable refuse from the clean-up of the bullion-melting department. A wide variation is noted in the amount of water passing through the plant. In the winter it is as low as 40 to 50 tons daily; in rainy weather in the spring, it often amounts to 1000 tons in the same length of time.

The assay-value likewise has fluctuated between a maximum of 20 cents and a minimum of 4c. per ton. Usually the high content appears in the early spring, when the frost is leaving the ground. Assays indicate a recovery of 75% of the gold on the low-grade waters, and a better precipitation on the high-grade. Since the plant has been in operation for about two years, during which time the tailing has had an opportunity to leach, the gold-content appears to be gradually decreasing. At the present time the maximum is about 10c. and the minimum 4c. per ton. Cyanide and alkali are barely noticeable.

Gasoline Locomotives. Seven-ton gasoline locomotives, made by the Milwaukee Locomotive Mfg. Co. are used on the tramway between mine and mill. The Decorah mine is almost a mile distant from the mill, over a nearly level grade. Midway between the termini mentioned is 'the Junction,' where ore-cars from the Empire and Portland mines are picked up by the locomotive and hauled to the mill. From this point to the mill the grade is level, and a train of 16 two-ton cars is easily hauled. From the Portland and Empire mines to the junction the mine-cars are dropped down inclines by electric-driven hoisting-engines.

All of the supplies for the mill arriving by the railroad, amounting to 50 tons per month, are transferred to tram-cars at the Empire. Lighter rails have been replaced by 30-lb. steel; switches and frogs are of heavy, standard, construction, the whole giving the impression of a thoroughly well-built track of 18-in. gauge. Two locomotives are owned, although ordinarily but one is in service, and that on day-shift only. The second is kept in reserve, in good repair. Each is given an annual overhauling when all worn parts are replaced. All mine-cars are equipped with Hyatt roller-bearings.

Welfare Work. To supply the demand for suitable homes for the employees, the company is erecting modern cottages, each of which is provided with water, electric light, sewage, a bathtub, and a good steel range. A hotel, to provide quarters for the bachelor members of the force, is being built. The school-house, which serves 80 to 90 children, is a model of neatness and reflects the interest the company's officials took in its construction.

The Trojan Mining Company is incorporated under the laws of the state of South Dakota, with one million shares. There are but four or five stockholders, the largest block being held by H. W. Seaman, of Chicago, who is president and takes an active interest in all of the affairs of the corporation. H. S. Vincent is general manager, H. P. Slaughter mine superintendent, Charles E. Ellis mill superintendent, C. E. Dawson engineer and purchasing agent, and W. A. Remer, chief clerk. To all of these I am indebted for courtesies. Each contributed his share to the matter discussed, but none of them suggested that the company was a dividend-payer. Possibly it was modesty that caused them to refrain from mentioning the substantial returns being earned. The Black Hills would be a better mining district if there were more enterprises having the capital and aggressiveness of this company.

Ancient gold mines in East Africa are stated to have been uncovered recently in the Mt. Elgon foot-hills. A correspondent writes to the *South African Mining Journal* to say: "Old mining-tools have been ploughed up on this farm, and the owner recently, in excavating a deep trench, unearthed fragments of enamel-ware kitchen-utensils from hard clay, where they must have been lying for thousands of years. No doubt the early Arabs of Yemen, known in history as the Sabeans, who worked the Zimbabwe goldfields of Mashonaland, found their way down here in ancient times when the world was young; or it may possibly have been the Persians who alternated with the Sabeans in successive waves of colonization for many centuries during the first settlement of the East African coast. Personally, the writer feels confident that we find here traces of the enterprise and daring of the old Sabeans, because some years ago, while traveling in Abyssinia and Arabia, he went into the question very carefully, with the result of being able to prove conclusively from extracts from the works of old Greek, Arabic, and Hebrew authors, in conjunction with local facts, that the ancient goldfields of Ophir were situated in Western Abyssinia, in a district not so very remote from Mount Elgon; and that in these days the Sabeans had caravan-routes stretching right across the continent. Ruwenzori, which they called Jebel Kaf, and the Congo pigmies, were known to them 1000 B. C."

Gold amounting to $1,600,000,000 has been produced by California, but according to an estimate of M. Laur, a French mining engineer, this is less than a quarter of the gold contained in the ridge between the Middle and South Yuba river, which he estimates at $6,000,000,000. Professor Silliman's estimate for the same region was $524,610,000, or less than one-thousandth that of Laur. This is by no means a record difference in estimates. Perhaps the greatest difference yet recorded relates to a gold mine in the wilds of Peru, the ore reserves being estimated by a local engineer at $600,000,000, while a London engineer found the 'ore in sight' at nothing.

Standardizing Rock-Crushing Tests

By M. K. RODGERS

*Reports of rock-crushing tests should include the following details:

1. Description of the machine employed (jaw or gyratory crushers, rolls, stamps, tube-mills, Chilean mills, etc.)

2. Material (timber, concrete, etc.) of foundation. Power is lost in the vibration of poor foundations.

3. Locality, geological, mineralogical, and physical characters of the rock.

4. The power consumption of the machine with no load and full load: the unit being 1 hp. per 24 hours.

5. The capacity of the machine in tons (of 2000 lb.) per 24 hours.

6. The duty in tons per horsepower-day.

7. The screen analysis of feed and product by the proposed A. I. M. E. standard screen-scale.

TOUGHNESS OF ROCK. Table I shows the relative duty of the same machine on three different rocks, all other crushing conditions being the same.

This table indicates that the specific resistance of the rock to crushing, may affect the crushing duty of a unit of power as much as 300%. Perhaps this quality may be called toughness. It is not a function of hardness only. For comparison of tests, rocks should be divided into at least three classes in this respect, determined by the crushing strength per square inch.

SCREENS. For screen analysis, a standard screen-scale, of a uniform ratio between sizes, should be used.

The results of an investigation made by the U. S. Bureau of Standards, with several of the large mining companies, where 240 to 260-mesh screens are used in connection with flotation tests, and including several cement manufacturers and screen manufacturers, are that a screen-analysis for all rock-crushing tests, and practically all testing of materials, will be covered by a screen-scale based on the U. S. Bureau of Standards, 200-mesh screen with a square opening of 0.0029 in. and a wire of 0.0021 in. diameter, advancing with a ratio of 1.414 (the square root of 2, suggested by Rittinger) between the successive sizes of screens, to a square opening of 4.197 in., the area corresponding to 4-mesh; for cases finer than 200 mesh, a 280 mesh or 0.0020 opening, with the above ratio, could be used.

If the analysis is to be carried finer than 0.0029 in. (200 mesh), the next finer sieve-opening in the Screen Scale Series, is 0.002 in. (280 mesh).

*Abstract of paper read at the September meeting of the American Institute of Mining Engineers.

TABLE I.—*Relative Crushing Duty of the same Rock-crushing Machine on Three Different Characters of Rock, all Other Crushing Conditions Being the Same*

Rock and Feed	Mill	Per Cent. Solids	H.p. of Machine	Tons per Machine, 24 hr.	Tons per Hp.-Day	Tons 200 Mesh per Hp.-Day	Screen Scale +4+10+20+40+60+100+200−200							
Calumet & Hecla conglomerate, ¼ mesh.	Conical tube 8 ft. by 30 in.	40	50.0	65	1.30	0.44	Feed	0	65	29	5	1	..	..	..
							Product	..	..	..	3	9	13	41	34
Cœurd'Alêne quartzite, F. M. & S. Co., 5 mm.	Conical tube 8 ft. by 22 in. 28 r.p.m.	43	47.5	112	2.50	0.67	Feed	0	43	43	11	1	1	1	1
							Product	..	..	2	22	18	19	12	27
Miami, ¼ mesh.	Conical tube 8 ft. by 22 in.	27	47.5	229	4.85	1.80	Feed	4	45	33	10	2	2	1	7
							Product	..	..	2	14	12	17	14	38

Relative crushing duty of 1 hp. due to character of ore only:

Calumet & Hecla Conglomerate	1.00
Cœur d'Alêne Quartzite	1.92
Miami	3.75

TABLE II.—*Standard Screen Scale*

Mesh per Linear Inch	Opening, Inches	Opening, Millimeters	Diameter of Wire, Inches	Diameter of Wire, Millimeters	Area of Openings, Square Inches
	4.20	106.60	0.375	9.52	17.64
	2.97	75.39	0.207	5.26	8.82
	2.10	53.33	0.192	4.88	4.41
	1.49	37.73	0.149	3.78	2.20
	1.05	26.67	0.149	3.78	1.10
	0.742	18.85	0.135	3.43	0.551
	0.525	13.33	0.105	2.67	0.276
	0.371	9.423	0.092	2.34	0.138
3	0.263	6.680	0.070	1.78	0.069
4	0.185	4.699	0.065	1.65	0.034
6	0.131	3.327	0.036	0.91	0.017
8	0.093	2.362	0.032	0.81	0.0086
10	0.065	1.651	0.035	0.89	0.0042
14	0.046	1.168	0.025	0.64	0.0021
20	0.0328	0.833	0.0172	0.44	0.00108
28	0.0232	0.589	0.0125	0.32	0.00054
35	0.0164	0.417	0.0122	0.31	0.00027
48	0.0116	0.295	0.0092	0.23	0.000135
65	0.0082	0.208	0.0072	0.18	0.0000672
100	0.0058	0.147	0.0042	0.11	0.0000336
150	0.0041	0.104	0.0026	0.07	0.0000168
200	0.0029	0.074	0.0021	0.05	0.0000084

If the analysis is to be carried finer than 0.0029 in. (200 mesh), the next finer sieve-opening in the Screen Scale Series, is 0.002 in. (280 mesh).

Points of View From Lake Superior

By P. B. McDONALD

Lucien Eaton, superintendent for the Cleveland-Cliffs Iron Co. at Ishpeming, has perfected what is called the Eaton-chuck for Leyner drills. This chuck has an anvil-block and does not require lugs on the drill-steel. If the drill-steel gets stuck in a hole, a wrench is used to loosen it. Lugs on drill-steel have always been a nuisance. The Eaton chuck has also been extensively adopted in the Copper Country. Drill-steel for use with it is merely cut squarely and a short hole reamed in the end.

In the Franklin mine, under superintendent Enoch Henderson, some fast driving was done recently. With ordinary working conditions and with no refinements of any kind, three miners per shift, with two No. 18 Leyner-Ingersoll drills mounted on a horizontal bar drove 284 ft. in one month of 26 working days, two shifts per day. Three trammers removed the broken ore to the shaft. A horizontal bar, instead of two columns, was preferred because set-ups could be made over a pile of broken rock and it was not necessary to wait for the tramming; also the bar took less room than the columns and arms. The so-called Leyner cut, utilizing many 'dry' or back-holes, was employed. The rock was the ordinary trap, a tough rock of moderate hardness. According to custom only two-thirds of a shift was worked on Saturday nights. This advance of 284 ft. is said to be a record for the Copper Country. Compared with the advance of 406 ft. of drift made by the Cleveland-Cliffs Iron Co. at its Morris-Lloyd mine near Ishpeming during 26 working-days in May, 1915, this record seems small. But in the iron-mine driving, four miners, six shovelers, and a portable loader were used on each shift, the resultant cost being $10 per foot. The Franklin cost was much lower and was made under ordinary conditions of working.

Mine-managers are doing some figuring as to ore-selection during the period of high prices for copper. These questions, which have been debated so seriously on the Rand, are prominent now at Houghton and Calumet. Is it more profitable to hurry the mining of high-grade ore and sell the greater extraction while prices are up or is it better to hoist a proportion of low-grade ore that could not be utilized at all during other times, for instance, some of the waste lying underground culled from previous years' production? The problem varies for different companies because of such factors as stamp-mill capacity, speed of tramming, and as to whether low-grade ore has to be removed to reach high-grade ore. The Copper Range Co. has pursued a somewhat different policy from most of the other operators, and has not kept its stamps so busy, evidently preferring to handle a smaller quantity of richer ore than other mines where maximum tonnage of ore is hurried to the mills. As to seeking tons of ore production rather than pounds of copper, it is an old story of how bosses on opposite shifts get to competing for the larger tonnage hoisted, and have sent up discarded waste-rock to swell the amount hoisted; in some cases on night-shift there has been even salting of the tops of the loaded ore-cars with better ore to assist in passing inspection or sampling tests.

Thought is being devoted to the hand-picking of copper-ore in the rock-house. Superintendents are asking if the removal of say 10% waste-rock at the mine prevents that quantity of material in the milling processes from 'maliciously' attaching to itself the 5 or 6 lb. of copper which the tailing is known to carry, or whether the waste-rock merely dilutes the tailing without 'grabbing' additional copper in the mill. Experiments are being conducted to determine the efficacy of careful hand-picking in the rock-house, say, by a force of boys working around a revolving circular table where water is sprayed on the crushed ore. The freight expense from the mine to the mill is also a factor of saving.

Hibbing, in Minnesota, one of the pioneer mining towns of the Mesabi range, has a queer condition of affairs. Local politicians with a control of votes have been taxing the mining companies and spending the money in an extravagant manner. Finally the mining companies, of which the U. S. Steel Corporation is one, refused to pay the taxes, and a deadlock ensued. The tax-gatherers threatened to close the mines by process of law, but recognized that if this were done, they would be cutting their nose to spite their face. The city of Hibbing is said to have been spending more money than Duluth, which is many times its size, and to have more street-lights than the city of Cincinnati, even the alleys being lighted to the brilliancy of the Great White Way of New York.

The United States Steel Corporation is trying the experiment of putting bath-tubs in miner's cottages on the Mesabi Range. The company hopes that the miners and their families will use the tubs for baths. In some districts the tubs make handy coal-bins or afford storage capacity for almost any household article, such as pickled pork.

Not much excitement is manifested in the new Kowkash gold rush to the north of Lake Superior in Ontario, although several years ago, several Michigan men achieved fortunes at Cobalt and Porcupine. It is believed that the Kowkash episode is only a small matter, like so many of the recent Ontario rushes. The insignificant gold showings of the Canadian border region across the Minnesota line have tended to discourage interest in the new Kowkash discoveries. It is scarcely believed that there will be another "poor man's camp," like Cobalt, where numerous rich deposits occur in concentrated form close to surface. It is interesting to note that Kowkash is approximately north of Calumet, and not far from the north shore of Lake Superior.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

SECONDARY ENRICHMENT seems to occur more commonly in connection with copper and lead ore.

GREASY MACHINERY may be cleaned quickly by directing against it a jet of steam from the boiler.

STEEL OR CAST-IRON SHOT, or granulations, or defective steel balls, from $\frac{1}{8}$ to $\frac{3}{16}$ inch diameter, are in demand for making bedding for jigs.

MINES of the Coeur d'Alene region are not situated in high rugged mountains, but in smooth-sloped hills at altitudes from 3000 to 4500 feet.

ASSAYS made at the Oriental Consolidated company's Tabowie office in Korea, during the past financial year cost 12.75c. each, on an output of 36,898 assays.

ALTITUDE does not affect men wearing mine-rescue apparatus. Four different types were tried at the top of Pikes Peak, Colorado, a height of 14,147 ft., by the U. S. Bureau of Mines at the end of August.

THE HIGHEST AND LOWEST places in the United States are in Inyo county, California. Mount Whitney is 14,522 ft. above sea-level while Death valley, 50 miles south-east is 300 ft. below sea-level.

PRODUCTS OF MINES supplied 57.22%, or 626,075,666 tons, of the total of 1,094,123,895 tons of all freight carried on railroads in the United States during the fiscal year ended June 30, 1915. The quantity was a slight decrease, but an increase in proportion.

PORTLAND CEMENT is made by mixing in proper proportions calcium carbonate and clay, which are heated to expel moisture. The mixture is pulverized and calcined at a high temperature to produce the so-called clinker, which is ground to pass a screen of 100-mesh.

THE POWER-PLANT at the Ford Motor Co.'s factory at Detroit is a combination of a producer-gas engine and a steam-engine, the exhaust gases from the gas-engine being used to jacket the steam-engine cylinders, and the exhaust from the steam-engine being used to assist in scavenging the gas-engine cylinder.

BEST RESULTS are obtained from wire rope with large size sheaves and drums; their use is strongly recommended. It is important that grooves be smooth and of sufficient size so that the rope fits easily, without wedging or bending on the side. When a groove becomes scored, it should be turned to eliminate the corrugations. If this is not done, shortened rope service will be the result, because of excessive wear on account of the rough surface. Another important factor is the keeping of drums and sheaves in alignment, otherwise there will be undue wear on the rope as well as on the sides of sheaves and drums.

WHETHER the formula H_2O applies to ice, liquid water, or to steam, was a question given to candidates for teacherships in high schools where chemistry is taught. Reasons for the answer were required. It is said that the effect of this innocent query on those being examined, university and technical school graduates mainly, was appalling.

ONE SEEKING to initiate a claim to mining premises legally located by another has the burden of proving that the annual labor thereon has not been performed, and thus establishing that the claim is ground subject to location. Copies of 'non-contribution' notices are admissible as evidence that work and labor on the claim have been performed in the past.

A LOCATOR of oil-lands, who has made his location and remains in possession, has a good title as against anyone but the United States. One who leases from such a locator under covenant that the locator has fee simple title cannot rescind the contract and recover consideration paid on the grounds that such a title is not fee simple, without first restoring to the locator such title as the latter had by relinquishing or returning the lease.

MAGNESITE PRODUCTS are giving satisfactory results, and are growing in popularity. It has most of the qualities necessary for floors, such as cleanliness (sanitary qualities), quietness, immunity from abrasion (surface wear), resilience, immunity from slipperiness, appearance, water-proof, plasticity, warmth (thermal insulation), life (immunity from deterioration with age), acid-proof, alkali-proof, fire resistance, elasticity, crushing strength, structural strength (rupture), immunity from expansion and contraction, and lightness.

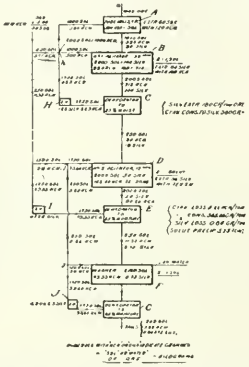
MORE MEN are killed in metal mining in the United States, in proportion to the number employed, than in the country's coal mines. It has been the custom to consider American coal mining as dangerous, because of accidents in which hundreds were killed at one time, but in metal mining a great number of small fatal accidents take place frequently. The fatalities per thousand men employed for three years are here given.

	1911.	1912.	1913.	Three-year average.
Coal mines	3.73	3.27	3.82	3.60
Metal mines	4.45	4.09	3.72	4.08

Evidently 'safety-first' precautions had a beneficial effect on metal-mine accidents in 1913, the rate being 3.72 as compared with 4.09 and 4.45, respectively, in the previous two years.

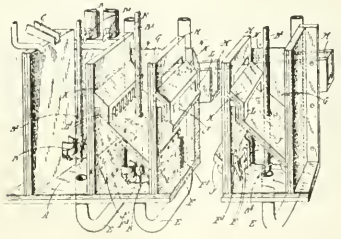
Recent Patents

1,156,382. Process of Extracting Metals from Ores. Robert S. Towne, New York, and Cyrus Robinson, Mount Vernon, New York, assignors to Metallurgical Engineering & Process Corporation, a corporation of New York. Filed July 14, 1910. Renewed March 8, 1915.



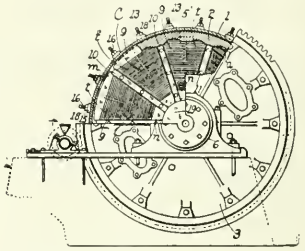
1. The herein described process for effecting the separation of soluble values from a mass, it consisting in subjecting the mass to the action of a solvent solution of comparatively high dissolving efficiency for a comparatively short period of time, positively and actively agitating the mass and the solution during the said period, subjecting the mass to a positive and active dehydration, thereby withdrawing from it a major portion of the solution together with the dissolved values contained therein, subjecting the remaining mass to the action of a similar solvent solution of comparatively low dissolving efficiency for a comparatively long period of time, positively and actively agitating the mass and the solution during the said period, subjecting the mass to a second positive and active dehydration thereby withdrawing from it a major portion of the second solution together with the dissolved values contained therein, and extracting the dissolved values from each of the said withdrawn solutions independently of the other.

1,155,815.—Apparatus for Ore Concentration. Arthur Howard Higgins and William Warwick Stenning, London, England, assignors to Minerals Separation, Limited, London, England. Filed November 12, 1913.



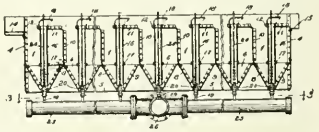
1. Apparatus for concentrating ores by gaseous flotation of certain mineral particles in liquid comprising, in combination, a vessel, means for introducing a gas therein at the lower part of the vessel, means for producing a zone of violent agitation and gasification in the lower part of the vessel, a baffle above the agitator for producing a quiescent zone in the upper part of the vessel, the baffle being inclined downwardly from the inlet side to the outlet side of the vessel, an inlet for the pulp to the vessel below the baffle, means for removing the froth from the upper surface of the liquid, and an outlet for the residues above the baffle.

1,152,239. Ball-Mill. Frank E. Marcy, Salt Lake City, Utah. Filed March 3, 1915.



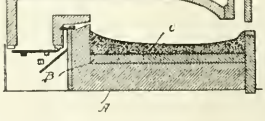
1. In combination with a drum rotatable about a fixed axis and provided with terminal heads having openings respectively for the feed and discharge of the material, a series of radial blades or lifters disposed on the inner surface of one of the heads, grate sectors having contiguous edges resting on the inner edges of the blades, and means engaging the edges of the sectors for securing the sectors to the blades.

1,156,372.—Agitator for Ore Treatment. Cyrus Robinson, Mount Vernon, New York, assignor to Metallurgical Engineering Process Corporation, a corporation of New York.



1. In an agitator for ore treatment, the combination of a receptacle adapted to contain a mixture of solvent solution and finely divided ore, a vertical tube mounted in the receptacle and terminating at its lower end above the bottom of the receptacle, an air nozzle at the bottom of the receptacle below and closely adjacent the lower end of the tube, means for delivering air to the nozzle to agitate the mixture in the tube and force it upward therethrough, means supplemental to the receptacle for receiving the mixture from the upper end of the tube, and means for entering the nozzle to cut down the effective cross area thereof.

1,155,628.—Method for the Treatment of Zinc Ore or Zinc-Bearing Material. Sewall Truax, Canon City, Colorado, assignor to Granadena Mining Co., a corporation of Arizona. Filed Dec. 16, 1910.

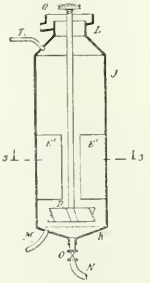


1. The herein described method of treating slag containing zinc comprising maintaining the slag in a fluid condition in

contact with a body of finely divided reducing material, the particles of which are prevented from passing into the fluid.

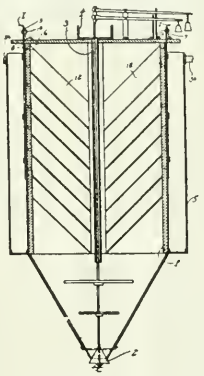
2. The herein described method of treating slag containing zinc comprising melting the slag, depositing the fluid on a solid body of finely divided carbon reducing material and a binder that prevents the particles of reducing material from passing into the fluid, and maintaining the slag in fluid condition.

1,155,836.—Apparatus for the Concentration of Ores. Thomas Mackellar Owen, Broken Hill, New South Wales, Australia, assignor to Minerals Separation American Syndicate (1913) Limited, London, England, Filed May 2, 1914.



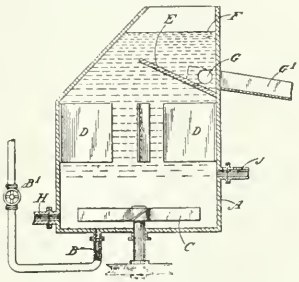
1. In an apparatus for concentrating ores by gaseous flotation of certain mineral particles in liquid, a single upright vessel open at the top comprising both an agitation and a separation vessel, an inlet conduit for ore pulp at the bottom of the vessel, an outlet conduit for tailings near the top of the vessel, a rotatable agitator in the lower part of the vessel, a conduit for air leading into the lower part of the vessel, vertically elongated baffles immediately above the agitator terminating at a substantial distance below the surface of the liquid in the vessel for producing a baffling zone above the atomizing zone and a substantially quiescent topmost and separating zone above the baffling zone.

1,156,276.—Slime-Thickener for Dewatering Mine-Tailings. Wilton E. Darrow, Sutter Creek, California. Filed February 8, 1915.



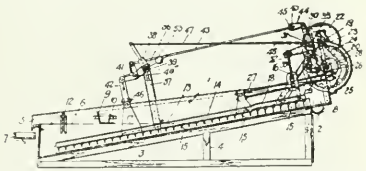
1. A device of the character described comprising a receptacle having a central inlet pipe extending to a point near the bottom thereof, a plurality of openings in the side of said receptacle, another receptacle disposed around said first named receptacle, said openings communicating with said second named receptacle, and a plurality of deflectors arranged in said first named receptacle, as described.

1,155,861.—Ore Concentration. Louis Albert Wood, London, England, assignor to Minerals Separation American Syndicate (1913) Limited, London, England. Filed June 2, 1914.



1. A process of concentrating ores which consists in subjecting the powdered ore suspended in water free from frothing agents to the admission of gas, forcefully disseminating the gas through the pulp in such a way that the gaseous bubbles preferentially attach themselves to certain mineral particles and rise toward the surface and discharge their mineral load with the pulp, and catching and removing such discarded mineral below the surface of the liquid.

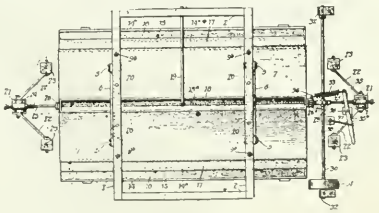
1,156,543.—Ore-Classifier. David J. Nevill, Denver, Colorado, assignor to The Dorr Cyanide Machinery Co., Denver Colorado, a corporation. Filed January 28, 1913.



1. In apparatus of the character described, a reciprocating rake having a pair of slotted hangers, and means for movably suspending said rake, including a pivotally mounted yoke extending loosely in the slots of said hangers.

2. In apparatus of the character described, a three-armed lever, a bell-crank operatively connected with one of said arms, a rake movably suspended from said bell-crank and another arm of said lever, mechanism for imparting a reciprocating movement to said rake, and a cam co-operative with said mechanism for engagement with the third arm of said lever to move the latter about its fulcrum at determinate points in said movement.

1,148,591. Ore-Concentrator. Orrin H. King, Wallace, Idaho. Filed August 2, 1912.



1. In an ore concentrator, the combination of a concentrating table which is suspended and arranged to have a slight endwise movement, abutments against which the ends of the table are adapted to strike, yielding means for normally holding the table in one end position against one of the abutments, and means for jarring and oscillating the table.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

LONDON

Tin Situation in Cornwall.—Sales at Redruth.—Tailing Treatment and Results.—Sale of an Old Estate.

The tin mines in Cornwall have a hard fight for existence nowadays. For many years the best miners have emigrated, and the proportion of capable hardworking men at the home mines has been comparatively small. Since the War began a great number of these capable men have joined the army, and the mines have been faced by a grave labor shortage. There is no boom in the metal for war purposes, the price remaining at a much lower figure than has been ruling in recent years. As the mines get deeper, the grade of the ore becomes poorer, and no bonanza shoots, locally called 'carbonas,' are found nowadays. Levant, the celebrated mine near Land's End, where the old manager used to delight to hocus his teetotal visitor's ginger-beer with gin, is on the verge of discontinuance. Francis Oats, of De Beers, and his son Freethy Oats, have spent much money and devoted much time to the resuscitation of this mine, but the owners of the mineral rights are making themselves obnoxious by their ridiculous terms in connection with a renewal of the lease, so that Freethy Oats has, without reservation, publicly stated that he is tired of the whole thing. If operations are suspended, the miners will find occupation elsewhere without any trouble, but the little community, other than the miners, will be hard hit, and a district that is bleak enough at any time will become still bleaker.

The fortnightly sales at the Redruth ticketings show a great fall in the amount of tin concentrate offered. On the reduced scale to which we have been accustomed for many years, these sales averaged 250 tons, and this figure was considered the irreducible minimum. The quantity is now still lower, having declined to about 150 tons. Dolcoath and Carn Brea & Tincroft both show decreases on account of the difficulty of finding ore of profitable grade. On the other hand, South Crofty continues to do excellent work, and recent developments at East Pool have been encouraging.

The companies formed to re-treat old tailing are not prosperous. The Cornwall Tailings Co., which treats the dumps at Carn Brea & Tincroft, extracts only 27% of the tin present as indicated by chemical assay. It is a comparatively big producer, selling a great deal more concentrate than most of the mines. During the past twelve months 144,460 tons yielded 432 tons of concentrate, but owing to the low price of the metal no divisible profit was made. The company was formed by an Australian group connected with the Broken Hill South and British Broken Hill companies. The managing director, Arthur Richards, is an engineer who has devoted a great deal of study to chemical methods of extracting tin from ores, so far in vain. The fact that only 27% can be obtained by water concentration helps to prove the contention that both old or new methods and plans have reached the limit of their efficiency. Cyanide came to the rescue of gold ores, and flotation to sulphides of other metals, but so far nothing has been found to supplement the older practice with tin.——Another company, more recently formed for the purpose of beneficiating old tin tailing, is the Carnon Valley Co. This is in the hands of the same group as the Cornwall Tailings Co., but has the additional advantage of the help and advice of Theodore Hoover, who is chairman of the company. The tailing is pumped from the river-bed to a re-grinding and concentration plant. Operations were started early this year, but were suspended after a run of four months. The scarcity of labor and the low price of tin combined to make the work unprofitable. But in addition to these drawbacks, the company has experienced much discomfort with regard to ancient rights and possession of property, and this circumstance played a large part in the decision to stop work for a time. I regret to say that the attitude of Cornishmen toward outsiders in matters of this kind is notorious.——A third tailing company of recent formation is the Cornish Tin Sands, the object of which was to re-treat the tailing on Gwithian beach, where material brought by the Red river from Camborne district is discharged. An extensive plant has been erected here, but more capital was required just about the time the War started, so there was no option but to close. The company is in debt, and will probably have to submit to compulsory liquidation, as a firm that supplied some of the machinery is a pressing debtor.

The most notable event in Cornwall at present is the sale of the Tehidy estate by Mr. A. F. Basset. This estate includes much property in the Camborne and Redruth districts and holds the mineral rights to many of the mines, including Dolcoath, South Crofty, East Pool, and part of Carn Brea & Tincroft. Many a time rumor has had it that Mr. Basset had parted with his possessions, which have been in the family for 800 years. On many occasions some sort of preliminary negotiations have been made on the part of mining companies with the idea of purchasing royalties outright. This time the news is really true, the purchaser being Robert Hamilton Edwards, who has earned fame and made money in the newspaper world as managing director of the Amalgamated Press, the Harmsworth organization owning popular monthly and weekly publications. The negotiations were conducted by Herbert Thomas, known by Cornish miners everywhere as the proprietor and editor of *The Cornish Post*. We believe that it was Mr. Thomas who suggested the purchase to Mr. Edwards. We may be sure that these two gentlemen will be more sympathetic to the mining industry than Mr. Basset, whose heart is about as hard as Cornish ore when mining deals are under consideration. Since Dolcoath was taken over by the present limited liability company 20 years ago, Mr. Basset has drawn £170,000 as dues. Mr. Edwards has indicated his intention of providing a big share of the capital required for sinking below the present depth, 3300 ft., where developments are extremely disappointing, on the off-chance of finding ore again. He has also announced that negotiations for the sale of mining rights will be invited and reasonable terms entertained. All Cornwall is looking forward with unusual interest to such benefits as may accrue from this transfer of the proprietorship of the Tehidy estate.

JOPLIN, MISSOURI

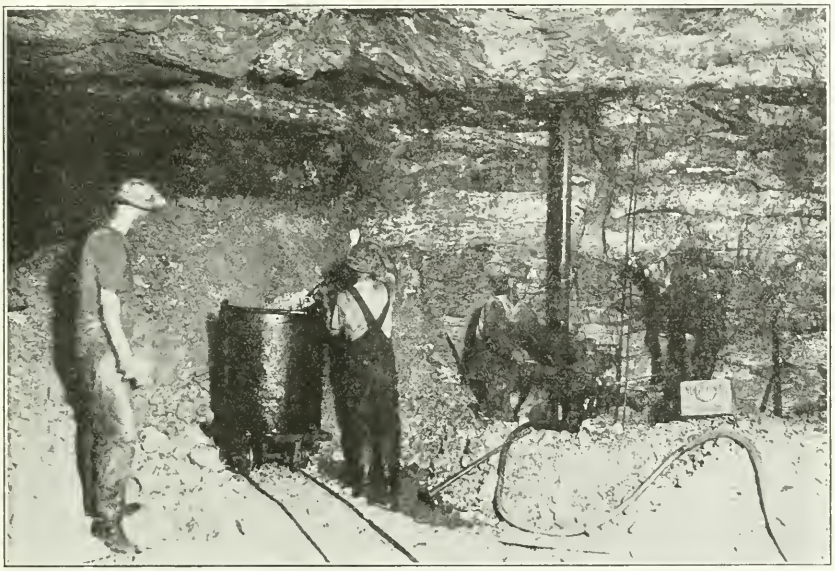
Importance of Sheet-Ground Development.—Mill-Building Activity is Unabated.—District's Largest Plant.—Zinc and Lead Notes.

Nothing could go further toward proving the importance of sheet-ground mining than the continued high prices for zinc ore. With zinc-blende selling at $75 to $85 per ton, basis of 60%, at the beginning of November, compared with a basis price of $40 to $44 at the beginning of that month of 1914, it can be seen that conditions are now much more favorable for the mine operator than they were a year ago. At present

prices, which give every promise of remaining firm for an indefinite period, handsome profits are to be made from zinc mining. At the prices that prevailed a year ago many sheet-ground mines were forced to close. It is true that in periods of low prices more attention, relatively, is given to the soft-ground mines, where the ore deposits are much richer, if not as extensive, than those of the sheet-ground properties; but with strong prices, like the ones that now prevail, the greatest profits are being reaped from the sheet-ground mines for the reason that while the profit per ton from the soft-ground mine may be much greater, the greatly increased tonnage from the sheet-ground mine more than offsets this feature. In sheet-ground development, a view of which is given in the accompanying picture, great areas of ground are cut out, supports being left at intervals depending on the character of the ground. The heaviest sheet-ground production is from the Webb City, Carterville, Porto Rico, Prosperity, and Duenweg, where the average depth of the orebodies is 200 ft. Faces ranging in height from 12 to 20 ft. are carried, and the mill recovery usually runs about 2½ to 3%, about 75% of which is blende, and 25% galena. Because of the opportunities afforded for profitable development in the sheet-ground areas more than a dozen large new plants have recently been constructed and many others are planned. In some instances the average richness of the ground is higher than 3%. In an isolated case or two a recovery of 6 or 7% has been maintained for a year or two at a time, but such instances are rare. In soft-ground mining, on the other hand, as high as 20 or 30% recovery is made, such yields, as a rule, being kept up for only a short time. An average recovery of 10% in soft-ground mining is considered good.

On a 20-acre lease of the Cornfield tract, first lease on which is held by the Zinc Corporation of Missouri, A. F. Dexter and associates have drained the old Century and Herald mines which were flooded in 1905, and which have not been worked since then, and let a contract for the erection of a 300-ton concentrating-plant to be operated by gas-engines. This land is a short distance south of Carterville. The lease lies south of the Luscombe property, and north of the new Kirkwood mill, which has reported a recovery of 5% since it started in operation several months ago. At the Dexter mine, both the old shafts will be worked. Where each of these shafts was equipped with a mill in 1905, one mill will now answer the purpose. Mining will be done at a depth of 165 to 185 ft., a big body of disseminated ore having been blocked out. Day and night shifts are to be worked in construction of the new plant, which will be equipped with new and modern machinery throughout.

On a 15-acre lease of the Missouri Zinc Fields land, south of Carterville, a contract has been let by the Ben Franklin Mining Co. for the construction of a concentrating-plant of 300-ton capacity. Recently this lease was purchased by the Ben Franklin Co. from Burns and others, who developed it. Work on the property, which is in the vicinity of some big-producing mines, shows an almost continuous body of zinc and lead ore from a depth of 155 to 200 ft. The upper part of the orebody lies in disseminated formation, which gradually blends with the sheet-ground formation, where it will be possible to carry a face about 15 ft. in height. All possible haste is to be made in the erection of this mill.



HEADING IN A SHEET-GROUND MINE, JOPLIN DISTRICT, MISSOURI.

Fast mill construction is to be started by Mattes Bros., who recently purchased from John Carey his lease of 15 acres on the Zinc Corporation of Missouri land, south of Carterville. A 300-ton plant will be erected. Tom Tarr will be in charge of building the mill. The land attracted a good deal of attention about a year ago, following several drill discoveries made by Carey, which showed ore from a depth of 135 to 200 ft. As is the case in other mines in this immediate vicinity, the upper portion of the orebody is of disseminated character with an underlying stratum of sheet-ground. Following the drill-holes, two large shafts were sunk, and both of these are now in ore, and driving has been started. Several drill-holes indicate that the orebody is extensive.

Work on the construction of a 150-ton tailing mill was started by G. Kusterer early in November, the material to be procured from several old tailing heaps on the lands of the South Carterville Mining Co., and the Ealor Mining Co. Great dumps of tailing accumulated there from early-day operations.

and assays show they contain enough zinc to make their treatment profitable.

Ben F. Wurzell and associates sold for $9000 their Sophia mine on the Budd M. Robinson land at Belville, north-west of Joplin, to the Emily Mining Co. The lease has a mill of 75-ton daily capacity.

At Granby, Missouri, the district's largest plant, the Klondike, is now in operation. It can handle 500 tons of ore per shift, and is receiving its ore supply from two shafts, which are 225 ft. deep. An extensive body of disseminated ore, 25 ft. thick, is blocked out with drill-holes and drifts. Electric power is used to drive the mill, hoists, and pumps.

That it is difficult to say just when a mine is worked out is shown at the properties of the Bradley Lead & Zinc Co. No. 1, and the Dutchman's Choice Mining Co. Both these mines are equipped with large concentrating-plants, and are situated on a tract of the St. Louis-Joplin Lead & Zinc Co.'s land at Chitwood, north-west of Joplin, where the old A. B. C. mine was worked. It was generally thought that the most of the ore had been worked out by the A. B. C. Co., the mill of which was burned several years ago. The new companies, however, are making large 'turn-ins,' the Bradley's production being especially noticeable, its output in a single week being 103 tons.

TIMMINS, ONTARIO

Further Discoveries Near Kowkash.—Plenaurum and Davidson Mines.

Besides the King-Dodds property at Kowkash, two discoveries have been reported from Tasliota lake, 20 miles west of Kowkash, and one mile north of mile-post 63 on the T. C. railroad. On one of the claims staked by Messrs. Devaney, Conners, and Morrison, a vein has been traced about 300 ft., averaging three feet in width, on which three samples have been taken yielding $8, $14.80, and $19.20 per ton; other samples gave as high as $62 per ton. In this vein free gold has been found associated with a steel-gray mineral, which proved on roasting to be a telluride compound. Qualitative tests on the same ore showed the presence of gold, silver, and lead, associated with tellurium.

Concerning the discovery on the Brennan claims at Tashota lake, and that on the Boyle claim at O'Sullivan lake, there are many rumors, but nothing definite is obtainable. An amusing feature of this rush is that at least one claim has been staked on an old diamond-drill hole, of which several have been found in this district.

It is reported on good authority that negotiations are proceeding between the La Rose interests and the owners of the Plenaurum, with a view to purchasing the latter, and work is about to commence preparing the Plenaurum for sampling. This, with the termination of the suit against the McIntyre Extension, and the control of the Jupiter by the McIntyre interests, will make the area north of Pearl lake active again in the near future.

The de-watering of the shaft in the Davidson claims at North Tisdale has commenced; negotiations are proceeding for the purchase of the Dohie claims in Deloro township, and the Success gold mines are being sampled by Auburn, New York, interests with a view to purchase.

TORONTO, ONTARIO

Work at the Principal Cobalt Properties.—Kowkash.—Miners' Strike.

Shipments of bullion from Cobalt continue light, as some leading producers prefer to store their output, hoping that there will be an improvement in the market. The statement of the Nipissing company on October 20 shows cash in hand $772,556, bullion in transit, $183,200; and ore in process and bullion ready for shipment $513,418; making total quick assets $1,460,174. The payment of the latest dividend brings the total disbursements to stockholders up to $13,440,000, or over twice the amount of the capital. R. B. Watson, general manager of the Nipissing, and party have returned from Le Pas in northern Manitoba, where they have been inspecting a rich discovery made by Jack Hamel, with a view to its purchase. No decision will be arrived at until careful sampling has been done.——Developments at the 385-ft. level of the Cobalt Lake property adjoining, disclosing ore of good width and grade, indicate that a large orebody on the Nipissing side of the boundary will be available.——The Coniagas has passed the dividend usually paid on November 1, the reason being that owing to the low price of silver the management has considered it advisable to curtail the output.——The spectacular 'silver sidewalk,' which attracted so much attention in the early days of Cobalt, has been sold by the La Rose Consolidated to the Ontario government, which will preserve the richest portion of it intact, as far as possible. It is now being carefully removed. Instead of blasting it, holes are drilled beneath it, which are filled with unslaked lime, and water poured in. The slaking of the lime will loosen the section to be taken out.——The Trethewey Mining Co. is operating the Rochester property from the 300-ft. level of the Lumsden, and has cut some patches of high-grade ore.—Another old-time producer which is being again worked is the Silver Queen, from which high-grade ore is being extracted.——The Crown Reserve has taken charge of the Globe Consolidated near Weaverville, Trinity county, California. It will spend $50,000, to be repaid out of gross ore receipts, taking 60% until the amount is paid off. Afterward the profits will go to liquidate outstanding liabilities amounting to about $253,000. For this assistance the Globe gives the Crown Reserve a 55% interest on a 30 years' lease.——The Temiskaming has cut a 5-in. vein of high-grade ore.——The Davidson property near Porcupine has been optioned to a Toronto syndicate, headed by Alex. Fasken, and is being unwatered.——At the North Thompson a high-grade vein was cut on the 200-ft. level, which, on being followed, widened to 23 ft., with ore of increased value.

Further discoveries in the Kowkash field are continually reported. Several wide dikes have been uncovered, showing rich ore on the surface. Tellurides have been found in several places. Many buildings are being erected, and a road eight miles long is being built from the King Dodd claims to Kowkash station, so that machinery can be brought in. The field has extended to Tashota, about 15 miles south-west of the King Dodds property, where many claims have been located. There is a regular Pullman car service in operation between Toronto and Kowkash, and the railway traffic is heavy.

The short-lived strike, involving about 2500 men employed in the asbestos mines around Thetford Mines, Quebec, occurred on October 18. Wages were reduced on the outbreak of the War on account of the weakness of the market, and the men asked that as conditions had improved the old rate be restored. They also demanded the abolition of the truck system, under which employees were compelled to trade at the stores of the companies. These demands were agreed to, and work was resumed on the 2nd.

In a circular sent to shareholders of the Dome Lake Mining Co. the directors state that recent developments have been favorable, and costs have been reduced. Production to August 31 was bullion worth $63,738, and concentrate valued at $9776 net from 9318 tons of ore. A cyanide-plant is necessary for better recovery of bullion. Stoping cost $4.13 per ton; driving, $12.30 per foot; sinking shaft, $49.93 per foot; sinking winze, $40.70 per foot; tramming, hoisting, etc., $1.31 per ton; and total mine operating costs, $3.90 per ton.

At the west end of the Chambers-Ferland mine three drills are at work. To cut the extension of one of the Nipissing veins cross-cutting is under way on the 275-ft. level. Two faults cross the Nipissing near the boundary, so exploration is rendered more difficult. Twenty-five men are employed in charge of J. A. McVichie.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Fairbanks

Road construction in this region was finished for the season last month. The Marconi Wireless Telegraph Co. may extend its all-night service to Fairbanks. Juneau has this service already.

It is estimated that the gold output of Circle this season was $300,000, of which the Berry dredge yielded $75,000.

It is reported that property in the Poorman Creek district, near Ruby, has been sold to B. Walker for $75,000.

Juneau

The Jualin Mines Co. will continue development through the winter, with H. G. Young in charge. Belgians control this property, headed by Jean Vanophem of Brussels, who was recently at Juneau.

At the Gastineau mill 6000 tons of ore is being treated daily. Costs of mining, milling, etc., are said to be 60c. per ton, against 75c., the original estimate.

ARIZONA

The utilization of the rare minerals and the non-metallics in Arizona is one of the first problems to be considered by the State Bureau of Mines at Tucson. The metallurgist of the Station, P. E. Joseph, is in charge of these investigations, which will be promoted by free publications that will be of great assistance to those interested in the mining industry. The first bulletin will be on manganese.

Cochise County

At Tombstone the Bunker Hill Mining Co. is busy with development and testing the ore.

Greenlee County

Recent events in the strike zone are as follows:

An arbitration board of five members has been suggested as a means of settling the dispute at Clifton. Strike leaders received the idea favorably. The militia has been increased.

The Secretary of the Department of Labor at Washington, D. C., has sent a commission to Clifton to investigate the strike.

Pascasio Heriz, a Catholic priest at Morenci, was forced to leave the district for his alleged anti-Western Federation remarks. The attorney for the Arizona Copper Co., W. C. McFarland, was also compelled to leave.

A levy of $1 to $2 per member has been voted by the Western Federation of Miners to help the strikers.

Yavapai County

For some months the United Verde Extension has been shipping 35 tons of ore per day, yielding a total net return from the smelter of $350,000. The current year's net will be about $500,000. Additional equipment will enable an output of 150 tons per day early in December. The new electric hoist has a capacity of 1000 tons per day. A 1200-ton storage-bin, and track to connect with the United Verde Copper Co.'s line that goes to the smelter at Clarkdale, are being constructed. If copper remains at its present price the Extension is estimated to earn $1,600,000 next year.

STRIKE MEETING IN THE PLAZA AT MORENCI.

CALIFORNIA

Butte County

Near Forbestown, the Zenith Iron Mine Co., consisting of Oakland people with L. A. Driesbach as president, is developing and extracting high-grade chrome-iron ore, which is being shipped over the Western Pacific line to the U. S. Steel Corporation at Pittsburg, Pa.

Money has been obtained to develop the South Banner company's property near Oroville. R. Phillips is in charge.

——At 300 ft. depth in the Lava Bluff mine, 20 miles northeast of Stirling City, coarse gold has been found. Owing to snow work cannot be conducted in the winter.

Inyo County

(Special Correspondence.)—The Lietzow Consolidated Mines Co. of California was incorporated on August 25 with a capital of 250,000 shares at $1 par. Improvements costing $8000 have been made on the mill-site near the San Pedro, Los Angeles, and Salt Lake line. An incline shaft has been started, also an open-cut. Ore is on the dump for shipment; it assays from $12 to $20 per ton.

Crucero, October 25.

The Skidoo Mines Co. is installing a small oil-fired boiler for heating cyanide solutions, to try and keep the leaching-plant working through the winter. Until development gives better results the 40-hp. gas-engine will not be installed.

Kern County

(Special Correspondence.)—Scheelite concentrates from the 'stringer' district are increasing in quantity. Purchasers of this product who are buying in small lots and paying cash are said to have "struck a snag" in shipments designed for Eastern markets. It is claimed that in less than carload lots, *via* the Santa Fe, (which would mean 40 to 50 tons worth about $60,000), the product must be forwarded by express. One indignant shipper is accordingly sending his by automobile to Los Angeles, bringing back suppiles on the return trip, saving time and money. The express rate is said to be $119 per ton.

Two electric motors, of 125 and 50-hp. respectively are being installed at Goler switch, by the Velmedith Mines Co., for pumping water from three 20-in. drilled wells. These wells are said to be able to provide water for the double purpose of placer mining at old Goler, and irrigating a farming tract near Garlock and Cow Wells.

The 2-in. pipe-line to Atolia from the Consolidated Mines will convey 20,000 gal. of water daily. Electric pumps will force the supply into a large tank on the divide over Rand hill, elevating it fully 600 ft. From the tank a gravity flow of 520 ft. will convey the water to the New Atolia mill.

Randsburg, October 28.

Nevada County

(Special Correspondence.)—Arrangements have been made for the installation of a hoist and pumping-plant at the California-West Point mine, to replace the works destroyed by fire last spring. New York capital is interested. E. S. De Golyer is superintendent. The property is in the Deadman Flat district, four miles below Grass Valley. Several properties in the district are active, including the Normandie and Kenosha.

Kansas people have become more heavily interested in the Black Bear mine, at Rough and Ready, and a 2c. assessment has been levied to finance more extensive work. Several improvements will be made to the mill and mine plant, and an endeavor made to recover the shoot of rich ore formerly worked. William Buchholz is superintendent.

A gasoline engine has been installed at the Union mine, near Banner mountain, and pipe-line placed for water supply to the hoisting-plant. Within two weeks the pumps will start unwatering the incline shaft, which is being cleaned out and retimbered to water-level. An option has been taken on the property by Los Angeles people, and an examination will be made shortly by J. Nelson Nevius.

The county assessor, Henry C. Schroeder of Nevada City, is developing the English Mountain quartz mine under lease. A strong shoot was recently found, samples returning $10 to $40 per ton in gold. James Holdsworth is superintendent.

Grass Valley, October 17.

The Dromedary mine at Grass Valley has been sold by the Berriman family to the Golden Center company for $18,000.

Placer County

At the Herman mine, five miles east of Westville, 20 of the 30 stamps are crushing 100 tons daily; shortage of water prohibits the use of the full mill. Forty men are employed. Winter supplies are going in.

Sierra County

At the Willoughby mine 20 tons of ore yielded $50 per ton; this is a new shoot.——The Keystone near Sierra City is being sampled and examined.——Sinking is under way at the Bald Mountain Extension gravel claims.

Trinity County

In the news pages of the Press last November was mentioned the case of J. Hoyle jumping the well-known Bullychoop mine, and re-locating the claims. A company is to be formed to further develop and extract ore from the property, which is well equipped.

Tuolumne County

Acting for Eastern capital, F. W. Page, manager of the Royal Consolidated mine at Hodson, Calaveras county, has taken a bond on the Republican property near the Eagle-Shawmut mine near Sonora for $65,000, on certain terms. The main shaft is 700 ft. deep; good ore is open between 500 and 650 ft. A 20-stamp mill is part of the equipment.

COLORADO

Clear Creek County

At the Capital mine the upper adit being driven to cut the Aetna vein is in 1000 ft., with 234 ft. to go. The advance in September was 120 ft., working one shift and hand drilling.

Work is to be resumed at the Gambetta zinc mine on Republican mountain.

Gilpin County

Machinery for the American Metals Producing Co.'s plant has arrived at Black Hawk, where it will be installed at the old Rocky Mountain mill.——The Senator company sent ore to the Iron City mill last week.——Good progress is being made in overhauling the 10-stamp mill at Mountain City.

Lake County (Leadville)

It is probable that the Yak mill in California gulch may resume work early in 1916; it has been idle for six years. Originally it was erected by the American Zinc Extraction Co., and bought later by the Sutton Steel & Machinery Co. of Denver. The ruling of the State Tax Commission will have an effect on the mill being started. It is assessed at $58,505, which is claimed to be too high.

Progress at the Anderson and St. Louis adits is good.

Teller County (Cripple Creek)

The Vindicator company paid its third quarter's dividend of 3%, equal to $45,000, on October 25. The total for this year is $180,000, and $3,217,500 to date. Net earnings for the quarter were $225,000, from which five notes were paid for the purchase of the Golden Cycle mine. This makes 19 paid. Development on No. 18 of the Golden Cycle has disclosed two different oreshoots, according to the president, A. J. Zang, making double the length of the orebody on No. 17 level, but of lower grade. Work on No. 16 and 17 levels has opened additional ore, and one drift on No. 17 has gone a good distance into Vindicator ground, and it will connect with No. 19 level of the Vindicator. Shaft-sinking is well under way. At 1600 ft. in the Vindicator work on the south extension of the north orebody has resulted in a large quantity of good ore being opened. Interesting developments are expected.

Lessees at the C. O. D. mine have shipped some rich ore from a shoot at 600 ft.——Lessees at the Abe Lincoln are producing from 75 to 100 tons of ore per week. Encouraging prospects are reported from the 800-ft. level.——Lessees at the Deerhorn are extracting ore from a depth of 80 to 100 feet.

Probably the Neville mill, on the Free Coinage property, Bull hill, will resume soon. The Zenobia dump is to be treated. Lessees at the Granite property on Battle mountain have cut from 8 to 18 in. of $34 ore.——The Dillon mine nearby shipped 500 tons of ore in 16 days.

According to an official note, the Golden Cycle mill at Colorado Springs would treat 43,500 tons of ore in October, a record.

So far the Ella W. mine has produced 17 cars of ore, and one car per day is the desire of the owners. This is from open-cut work. Others on Tenderfoot hill are active.

The flow of water from the Roosevelt drainage-tunnel is 13,000 gal. per minute.

The recent fine weather has stimulated prospecting in the district, and rich ore has been uncovered at Wanack hill, just outside of the city limits.

IDAHO

Shoshone County (Coeur d'Alene)

Antimony properties in this region are being actively developed and prepared for production, the Coeur d'Alene Antimony Mining Co. being especially busy on Pine Creek. Ore buyers are reported to be bidding keenly for the outputs of the mines.

Bins at the National mine are filled with copper ore, and with a good supply in the mine it is expected that the 500-ton plant will soon commence.

On November 4, the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 218, or $81,750; this makes the total dividends $16,609,500.

It is stated that the Interstate-Callahan company will declare a dividend of $2 per share, equal to $920,000; this will make $1,840,000 since April, and $2,760,000 to date. The output in October was 650 tons of concentrates and crude rich ore.

On November 5 the Caledonia company paid 3c. per share, but as silver is so low the next dividend will be less. The ore is high in silver. Thirty men are employed.

ILLINOIS

Jo Daviess County

(Special Correspondence.)—At Galena, the re-built Joplin separator works is now in operation after several years' idleness, under the control of the Wisconsin Zinc Co. The big producer of this district is the Black-Jack mine formerly the Marsden. Six to 10 cars weekly are recovered here. Federal, North Unity and Great Western mines are steady producers in this camp.

Galena, October 20.

MISSOURI

Jasper County

Owing to the better prices for ores during October it is expected that miners' wages will be increased 25c. per day, while shovelers will get from ½ to 1c. per can extra.

MONTANA

Silverbow County

Approximately 16,000 men are employed in the Butte district. Miners receive $4 per shift at present, so the weekly wage totals $384,000.

The Butte & Zenith mine, six miles from Butte, is likely to be re-opened soon, according to the president, J. Freimuth of Duluth. The property was closed a year ago. The main shaft is 600 ft. deep, and exploration is expected to reveal ore.

At the Butte-Alex Scott mining is under way at 1900 and 2000 ft. depth, while a new level is being opened at 2200 ft. The shaft is to be sunk 200 feet.

The Tuolumne expects to increase its output from 100 to 150 tons per day. Most of the work is at 2000 ft. Stope sets are being placed at 2600 feet.

The Davis-Daly is shipping 7% ore, the output being 100 tons daily. Development at 2500 ft. continues excellent.

The jury's verdict at the enquiry into the North Butte disaster was as follows:

"We find that the cause of death was from shock and internal hemorrhage from injuries received in a giant powder explosion at the Granite Mountain shaft of the North Butte Mining Co. The explosion occurred from some cause unknown."

The powder used, according to S. R. Russell of the du Pont Powder Co., was gelatine-dynamite. The last sent to Butte was made on September 1, 1915, and it was part of this that exploded. Of 12 boxes remaining the product was in excellent condition. The dropping of a stone on a box of dynamite was not considered the cause, as tests of a 2 by 4-in. stone from a height of 75 ft. failed to dent the wood sufficiently to affect the powder.

NEVADA

Elko County

The town of Jarbidge has a population of over 1500 people, and is busy and prosperous. The monthly gold output of the mines is more than $50,000.

Esmeralda County

There are 2800 men employed in the Goldfield district at present, and the town has a population of 4000. The monthly pay-roll is about $300,000.

The final report of the Goldfield Consolidated for September is as follows: ore treated, 32,500 tons; profit, $112,847; net cost, $4.44 per ton, and development, 2204 ft. at $4.60 per foot. Exploration resulted in little of importance. Lessees produced 837 tons of ore with a gross value of $13,109, from which the company received $6908 less the cost of milling and transportation.

Shipments of $40 ore are to be started from the Atlanta 1580 and 1620-ft. levels. The vein at these depths assays $25 to $35 per ton in gold, and 3 to 6% copper.——The Simmerone is also to ship some ore.

At 840 ft. in the Kewanas the ore-shoot has been opened for a length of 160 ft., the north drift for some distance showing 3½ ft. of $40 ore. The ore will be hoisted through the Laguna shaft of the Goldfield Consolidated through which the operations of the Kewanas company are conducted, and where there are good shipping facilities.

At a depth of 1175 ft. in the Merger, the north-east cross-cut is now in quartz in the latite. This work is to explore for the south-east continuation of the rich shoot of the Jumbo Extension.

Six parallel drifts, on different levels, have been opened in the rich shale contact orebody of the Jumbo Extension and all are showing ore of uniformly high grade, extending over a wide area. The most notable of recent developments has been the driving of the 530 drift, about 60 ft. above the 1017-ft. level, and the farthest point to the south-east that has been reached on the contact ore-channel. This drift has been extended over 130 ft., and for this distance has been in ore of high average grade, often assaying over $100 per ton across the full face of the drift.

Nye County

Production of companies and lessees at Tonopah last week totaled 9891 tons worth $203,998.

At 1200 ft. in the Halifax mine rich silver-gold ore has been opened.——A new shoot has been opened at 1350 ft. in the Extension.——The Belmont looks better at present than at any time in the past three months.

White Pine County

The tax-roll of this county is fixed at $13,030,585. The Nevada Consolidated valuation was raised $1,053,111 to $4,724,891; Giroux Consolidated, $82,047 to $183,925.

UTAH

Boxelder County

The Lakeview Mining Co.'s property at Promontory Point

has been optioned to the A. S. & R. Co. for $625,000. High-grade zinc ore is being extracted.

SUMMIT COUNTY

Labor troubles commenced at the Silver King Coalition mine, Park City, on October 26. Insurance, hospital dues, and discharge of certain men are said to be the causes of the dispute. The men are quiet and determined, and have made some concessions. On the 28th the firemen, engineers, and pumpmen 'downed tools,' but the pumps are being worked by several of the men. Prospects of an early settlement are considered good.

WYOMING

It has been found impossible so far to cap the great gas well, which is wasting 250,000,000 cu. ft. per day. The derrick has been destroyed. Engineers of the Montana-Wyoming Oil Co. are constructing a large concrete ring around the well to give a firm anchorage for capping. This well is near Byron.

CANADA

BRITISH COLUMBIA

With one furnace in blast during September, the British Columbia Copper Co.'s net earnings were $7000. The monthly output of copper is 350,000 lb. There are 150 men employed.

Ore from the Lucky Jim mine being treated at the Roseberry mill, near New Denver, is averaging 45% zinc. The output of ore is 100 tons per day.

ONTARIO

If the shareholders agree, the McIntyre company is to acquire control of the Jupiter property at Porcupine. The McIntyre Extension was secured in August, and with the Jupiter the underground work can be better consolidated. The price for the Jupiter control is $152,000. Its ore will be treated in the McIntyre mill, which is being enlarged. The September yield of the McIntyre was $70,268 from 8395 tons of ore, with a profit of $32,723.

During September the Alexo nickel mine produced 583 tons of ore, a decrease.

KOREA

The Oriental Consolidated September bullion production was valued at $131,700.

MEXICO

CHIHUAHUA

(Special Correspondence.)—The Carmen mines, situated in Mexico, just across the Rio Grande from Boquillas, are to be again operated on an extensive scale. The ore is rich in silver and zinc. The property was operated for several years by Germans. It is now owned by F. C. Morehouse and associates. The revolutionary disturbances in Mexico caused the mines to be shut down a few years ago. Ore was transported across the Rio Grande by means of a cable-way; from the landing on the American side it was hauled to Marathon, on the Southern Pacific railroad, 100 miles, in large gasoline trucks. It was found, however, that this method of transport was too expensive, and it is the plan of the owners to place in service 200 wagons between Boquillas and Marathon. Plans are being made for the construction of a line from either Alpine or Marathon to Boquillas, and it is probable that the proposed road will be extended some distance into Mexico.

Boquillas, Texas, October 24.

SONORA

At the end of last week 30 employees arrived at Naco and Douglas from El Tigre. They were not interfered with by Villa.

According to George Kingdon, superintendent of the Greene-Cananea company, conditions at the property are quiet. At the Puertecitos mine, eight miles away, 400 men are working; and 100 at Cananea.

PERSONAL

PHILIP ARGALL is here from Denver.

D. M. RIORDAN has returned hither from New York.

J. POWER HUTCHINS is in the Altai region, Western Siberia.

PIERRE BOUERY, manager of the La Grange mine, is at Boston.

C. W. PURINGTON is due in London on his return from Siberia.

CHARLES T. HUTCHINSON, manager of the PRESS, has returned from the East.

JULIUS RODMAN of Denver is investigating tungsten prospects in Nevada.

L. J. MAYREIS, manager of the Tanalyk copper mine, Russia, is now in London.

GEORGE A. DENNY, until recently in Mexico, has gone to South Africa.

NORMAN C. STINES is in London, on his return from the Ural region, Russia.

SCOTT TURNER has left Tromso and is now in London, on his return to Michigan.

SUMNER S. SMITH has returned from the Matanuska coalfield to Juneau, Alaska.

WALTER BEAM, of Denver, is inspecting mines in the Mother Lode region of California.

JOHN W. FINCH and WILLIAM H. EMMONS are testifying in the Elm Orlu suit at Butte.

F. O. WILLIAMSON of Chicago is making an extensive tour of the western and southern states.

HAROLD B. GLEESON has succeeded GEORGE MACFARLANE as manager of the Mawchi mines, in Burma.

ARTHUR NAHL, manager of the Progreso mine, at Triunfo, Lower California, has returned to Oakland.

THEODORE CHAPIN, of the U. S. Geological Survey, has returned from Ketchikan, Alaska, to Washington, D. C.

STUART A. INGRAM is engaged in erecting a cyanide plant for Messrs. Crowell, Findley & Parsons at Chloride Cliffs, near Rhyolite, Nevada.

OTT. F. HEIZER has resigned the management of the Argo mill, at Idaho Springs, Colorado, where he is reported to have done excellent work.

Schools and Societies

A scholarship endowment estimated to be worth more than $100,000 has just been given to the regents of the UNIVERSITY OF CALIFORNIA, to constitute the Joseph Bonnheim Memorial Fund, for the maintenance of scholarships for young men and women at the institution.

The Joplin, Missouri, branch of the A. I. M. E. met on October 28. There were over 40 members present, including the local and St. Louis men. The sessions included visits to the mines, a dinner, and several papers on geology, mining, milling, leasing, and the activity of the district.

The annual meeting of the California Metal Producers Association was held in San Francisco on October 27. The executive committee re-elected was as follows: ALBERT BURCH, president; G. W. METCALFE, first vice-president; E. C. HUTCHINSON, second vice-president; G. W. STARR, C. E. KNOX, N. CLEAVELAND, and S. W. MUDD. R. I. KERR was elected secretary-treasurer. An increase in membership of nearly 100% since organization is reported, representing approximately 90% of the capital invested in metal mining in the state of California.

THE MARKET PLACE

Weekly summary of metal prices and notes on the markets.

Metal Prices

San Francisco, November 4.

Metal.	Cents per pound.
Antimony	37
Electrolytic copper	19
Pig lead	5.15— 6.10
Quicksilver (per flask)	$97.50
Spelter	16
Tin	37
Zinc-dust, 100-kg. zinc-lined cases	26 —30

Prices for prompt delivery of zinc-dust are as high as 35 cents.

ORE PRICES

Antimony: market irregular, 50 and 60% products, free from deleterious impurities, per unit.....$1.60 and $2

Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....30.00

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, November 4.—Copper is firm with large enquiries; lead is quiet but firm; zinc is very strong, though moderately active.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct. 28	49.25	Sept. 22	48.85
" 29	49.37	" 29	49.29
" 30	49.37	Oct. 6	49.64
" 31 Sunday		" 13	49.55
Nov. 1	49.25	" 20	49.53
" 2 Holiday		" 27	48.91
" 3	49.62	Nov. 3	49.37

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The undertone of the silver market remains good, with advancing prices. Little support is coming from India and China. The English and Continental demand for coinage continues fair. Coinage reform is on foot in China, and spread over several years the value of silver absorbed would be worth 266,000,000 Chinese dollars, worth 50c. U. S.

On October 30 a shipment to China amounted to 150,000 oz. The last report of the Tonopah Mining Co. shows silver on hand worth $949,752, nearly 2,000,000 ounces.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Oct. 28	17.87	Sept. 22	17.75
" 29	17.87	" 29	17.87
" 30	17.87	Oct. 6	18.00
" 31 Sunday		" 13	18.00
Nov. 1	17.87	" 20	17.87
" 2 Holiday		" 27	17.79
" 3	18.00	Nov. 3	17.89

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended October 16 totaled 25,359,789 lb., worth $4,860,809. Of this, France took 11,603,698; England, 6,460,009; Russia, 4,625,532; Sweden, 1,568,426; and Italy, 391,419 lb. Imports amounted to 3,893,863 lb., valued at $543,630. Cuba supplied 1,015,980; Chile, 1,000,313; and Japan, 974,275 pounds. September outputs were: Chino, 5,254,286; Nevada Con., 6,021,850; Ray Con., 5,131,466; and Utah Copper, 14,159,289 lb. The last named yielded 15,000,000 in October.

Anaconda is earning $25,000,000, or $10 per share, per year. An increased dividend is expected. All its copper is sold to January 1. Sales in October were 25,000,000 pounds.

On January 1 the Chile Copper Co. will be treating 10,000 tons of ore daily, worth $2.50 per ton at 13c. per lb. for copper. It is suggested that the output be increased to 30,000 tons per day. Reserves are 400,000,000 tons.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Oct. 28	14.75	Sept. 22	13.58
" 29	14.87	" 29	14.23
" 30	14.87	Oct. 6	14.37
" 31 Sunday		" 13	13.55
Nov. 1	15.00	" 20	13.37
" 2 Holiday		" 27	14.12
" 3	15.12	Nov. 3	14.92

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.95
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

Prices for zinc ore at Joplin, Missouri, are stronger, and during the past week the output of the region was as follows: zinc-blende, 6400 tons; calamine, 346 tons; and lead, 955 tons, averaging $82.52, $50.50, and $53.04 per ton respectively. The total value was $528,053, and for 44 weeks, $19,990,251.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct. 28	4.75	Sept. 22	4.50
" 29	4.90	" 29	4.50
" 30	4.90	Oct. 6	4.50
" 31 Sunday		" 13	4.50
Nov. 1	4.90	" 20	4.50
" 2 Holiday		" 27	4.75
" 3	4.90	Nov. 3	4.87

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

Owing to the embargo on the export of lead from Australia, the Chinese market, which has been mostly supplied from there, is in a serious condition. The annual imports to China average about $570,000.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Date.	Week ending		
Oct. 6	90.00	Oct. 20	92.00
" 13	92.00	" 27	93.00
		Nov. 4	97.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

Actual sales have been made at $97.50. Supplies are low and the demand is large.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin on November 3 was firm at 36 to 36.50 cents. L. Vogelstein & Co. reports the visible supply at September 30 at 17,286 tons, against 17,094 tons at that time last year.

Eastern Metal Market

New York, October 29.

In the past three or four days the entire market has shown a better tone, and metal prices have advanced without exception. Even consumers concede that copper is likely to go higher. At the present time none is to be had under 18c., and some of the producers are quoting 18.25c. Exports during the month show an improvement. The London price of electrolytic has advanced 10s. over £88. The London quotation for zinc is now £71 10s., and the domestic market is higher also, business having been brisk. Lead has been in heavy demand from Canada and Russia, and this started domestic buyers; as a result of which the New York price has been put at 4.90c., an advance of $3 per ton. The report that Great Britain was planning an export duty on tin has been discredited, and the information started buying of all positions with consequent higher prices. Antimony is tightly held at 35 to 36c., which is not far from the record established in June. Aluminum is extremely scarce, even at its present high price and presents a situation that is troublesome to consumers.

The steel mills are flooded with orders from at home and abroad. The scarcity of open-hearth steel is such that the wider use of Bessemer steel is being urged on many sides. Machine-tool interests continue to combat strikes in the East and in the Middle West. Deliveries are certain to be considerably delayed by the labor troubles.

COPPER

The large producers have great faith in the future of copper. They held to 18c., 30 days, delivered, until today when they went to 18.25c. The metal has been available from secondhands, and some of the smaller producers at 17.75c., cash, New York, making the range of prices 17.75 to 18c. but these prices will be withdrawn. In the early part of this week the market stiffened and 17.87½c. was about the best that could be done; but this was but temporary, and quotations receded to 17.75c., then came a second advance. There is a belief, which is shared by some large consumers, that copper will go still higher than it now is. A good business was done up to October 27, but it was mostly in Lake, inasmuch as this grade commanded no premium over electrolytic. Most of the buying was on the part of war contractors who cover the requirements of every contract as taken. Others refrain from buying far ahead. The domestic consumption continues below par, even the electrical industry not taking anywhere near what it does in normal times. The London price stood for weeks at £88 until today when it advanced 10s. The state of foreign exchange, the pound sterling being quoted on October 26 at $4.61½ and on the 29th at $4.63½, has had a continued bad effect on the market so far as export buying is concerned. Yet exports for the month show improvement, amounting at October 29 to 21,212 tons; but this does not take into account all manufactured products.

ZINC

War munitions' requirements, and a higher market at London, have combined to send zinc quotations upward. Holders were asking, October 28, 14.75c., New York, and 14.50c., St. Louis, for prompt shipment. November was quoted at about 14.50c., December at 14c., and first quarter at 13 to 13.25c. A few weeks ago contracts for the first quarter could be placed easily enough at 10c. Prompt deliveries are active. Some consumers are getting irritated over the irregularity of the market, and, where they can safely do so, are contracting ahead at good prices. A manufacturer of composition bearings, for instance, who does a large business with the builders of machinery, has bought well into next year, and willingly paid a high price on the theory that it was worth something to know that his future supply was secure. The London quotation on October 28 was £70 10s., against £63 10s., on the 22nd. The domestic galvanizing trade continues a poor consumer, though the jobbing trade is showing signs of improvement. Exports have been heavy, totaling 6062 tons up to October 30.

Sheet zinc is unchanged at 16c. f.o.b. smelter, carload lots subject to a discount of 8% for cash.

LEAD

From October 21 to 29 the New York quotations of both the A. S. & R. Co., and independent producers stood at 4.75c., New York, and 4.62½ to 4.76½c., St. Louis, but on the latter date they advanced to 4.90c. New York. The advance was precipitated by heavy buying for export, especially to Russia and Canada. The London market on the 28th was quoted at £24 2s. 6d. The lead market is in a healthy condition, with some of the sellers having nothing to offer for the next two or three months. Exports have been heavy, some having been made by way of New Orleans, where shipping conditions are easier than they are on the Atlantic seaboard. Shipments of the month up to October 30 totaled 3806 tons.

TIN

It was learned this week that the report as to Great Britain contemplating an export duty on tin originated in this country. It probably was given currency for the purpose of influencing the market. English authorities have denied that such a duty had been proposed in London, but say that since the suggestion was made it is likely to be imposed. With the passing of the fear of an export duty a good business was done in all positions of tin, and prices have advanced. The quotation yesterday was 34.75c., spot delivery. With the activity developed a tendency on the part of some operators to gamble by buying on the basis of sterling exchange, their idea, of course, being that the pound sterling will soon advance. The arrivals this month will be insufficient to meet deliveries and stock will be drawn upon. The arrivals up to October 30 amounted to 2000 tons, and there was afloat on that day 4000 tons.

ANTIMONY

Antimony is fast approaching the high record of June, when 38c. was quoted. Chinese and Japanese are quoted at 35 to 36c., duty paid. Canada has been a heavy buyer. The trade believes that the high market will be short-lived, as it is based largely on the shortened supply, and this will soon be corrected. Meanwhile, a sellers' market prevails.

Thomas F. Wettstein, of the United Lead Co., in discussing the effect of the War on the metals, before the recent meeting of the Institute of Metals, said; discussing antimony, that it is perhaps the only metal of the non-ferrous type, of which it can be definitely stated that its present high price is directly attributable to the War.

ALUMINUM

The market continues firm at from 53 to 56c., and all the indications are for higher, rather than lower prices. Consumers of the metals are more puzzled over aluminum than any other metal, for it is difficult to find, even where there is willingness to meet quotations.

The San Francisco Mint reports as follows for September: Australian and Chinese gold bars received, 118,214 oz.; English and Japanese coin, 486,032 oz.; and other gold, 243,748 oz., a total of 847,994 oz., valued at $17,529,585. Silver receipts totaled 52,672 oz., worth $25,083. Coinage executed only amounted to $113,000 and ₱6000. Coin, bullion, on hand at the end of September amounted to $330,635,965.43.

BOOK REVIEWS

Internal Combustion Engines. By Robert L. Streeter. P. 409. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by the Mining and Scientific Press. Price, $4.

The first few chapters of this volume are mainly introductory and contain the usual information regarding the laws of gases, energy, the history of the internal-combustion engine, the Otto cycle, etc. Liquid and gaseous fuels are then discussed. The Otto and Diesel cycles are considered and compared. Considerable space is then devoted to ignition, carburetion, and governing. Power, efficiency, and the cost of power as generated by the different types of engines are then discussed. The different types of both oil and gas engines are described as well as the Humphrey gas-pump. The remainder of the book is devoted principally to engine-design.

Valves and Valve-Gears. Volume II. By Franklin De-Ronde Furman. P. 437. Ill., index. John Wiley & Sons, Inc., New York. For sale by the Mining and Scientific Press. Price, $2.

The first volume of this work, dealing with valves for steam engines and steam turbines, was reviewed in Western Engineering for June 1915. The present volume continues the subject, discussing gasoline, gas, and oil engines. The treatment is the same as in Volume I, and amplification of notes for a college lecture-course, but both volumes will prove valuable to the engineer as well as to the student. The general theory of admission and exhaust for both two and four-cycle engines for different arrangements of cylinders is discussed, together with the various methods of ignition. The application of this theory to the design of valves for ordinary gasoline engines is then considered. A chapter is devoted to the special problems encountered in the design of aeroplane-engines. Valves for gas engines, ordinary oil engines, and diesel engines are considered in turn, and the book closes with a few remarks on the comparative efficiency of the various prime movers.

Purchasing. (Its economic aspects and proper methods). By H. B. Twyford. P. 236. Charts, 112 plates, index. D. Van Nostrand Co., New York, 1915. For sale by the Mining and Scientific Press. Price, $3.

An excellent text book and guide for the instruction of purchasing agents and those whose partial duties include the placing of either large or small orders. Considerable time and money would be saved by both buyer and seller if the principles as outlined by the author were carefully followed by our present day purchasing agents. The splendid example of system as outlined in this book is in itself well worth the consideration of many who are only indirectly connected with actual buying.

RECENT PUBLICATIONS

Bibliography of Minnesota Mining and Geology. By Winifred Gregory. P. 157. Minnesota School of Mines, Minneapolis, 1915.

Conceptions Regarding the American Devonic. By John M. Clarke. P. 19. University of the State of New York, Albany, 1915.

Electro-Plating with Cobalt. By Herbert T. Kalmus, C. H. Harper, and W. L. Savell. No. 334. P. 69. Charts. Department of Mines, Ottawa, Canada, 1915. Results of researches on cobalt and cobalt alloys conducted at Queen's University, Kingston, Ontario, for the Mines Branch of the Department of Mines.

Report of the Sludge Abatement Board for 1914. P. 16, and 17 plates. Government Printer, Melbourne, Victoria, Australia, 1915.

Mineral Resources of the Philippine Islands in 1914. P. 41. Division of Mines, Bureau of Science, Manila, 1915. Abstracts will appear in the Press.

Annual Report on Dredge Mining and Hydraulic Sluicing in 1914. By A. H. Merrin, chief mining inspector. P. 16. Government Printer, Melbourne, Victoria, Australia, 1915.

Purchase and Sale of Illinois Coal on Specification. By S. W. Parr. Bulletin 29. P. 111. Ill., maps, index. Illinois State Geological Survey, University of Illinois, Urbana, 1914.

Revision of the Tertiary Mollusca of New Zealand. Part II. By Henry Suter. Palaeontological Bulletin No. 3. P. 69. 9 plates, index. New Zealand Geological Survey, Wellington, 1915.

Report of the Department of Mines of Western Australia for the Year 1914. P. 32. Perth, 1915. The 1913 report covered 244 pages, so probably financial conditions and the state of the industry did not warrant a detailed description of work done. The mineral output was worth £5,533,990, a decrease of £502,125. Gold accounted for 94.64% of the total production.

Annual Report of the Department of Mines of the State of Kentucky for 1914. By C. J. Norwood, chief inspector, and the Assistant Inspectors. P. 259. Head office, Lexington, Kentucky. The coal output was 20,168,150 tons from 364 mines operated by 270 companies in 29 counties. About 32,000 men were employed.

Road Construction and Maintenance. Published by the E. I. du Pont de Nemours Powder Co., Wilmington, Delaware. P. 120. Illustrated. In these days of heavy traffic proper road construction is highly important, and enormous sums of money are being spent in such work throughout the country. This interesting book discusses location of roads, clearing the right-of-way, drainage, construction, and maintenance. Details of blasting trees and rocks are especially practical and valuable, as they should be, coming from such a source. The work has been carefully prepared, and is of use to miners, road engineers, and farmers.

U. S. Geological Survey, Washington, D. C., 1915.

Results of Spirit Leveling in California. 1907 to 1910, inclusive. Bulletin 481. P. 115. Ill., index.

Rhode Island Coal. By George H. Ashley. Bulletin 615. P. 62. Ill., map, index.

Iron Ore in Cass, Marion, Morris, and Cherokee Counties, Texas. By Ernest F. Burchard. Bulletin 620-E. P. 41. Illustrated.

Quicksilver Deposits of the Mazatzal Range, Arizona. By F. L. Ransome. Bulletin 620-F. P. 18. Illustrated.

Iron-Bearing Deposits in Bossier, Caddo, and Webster Parishes, Louisiana. By Ernest F. Burchard. Bulletin 620-G. P. 22. Illustrated.

Statistics of the Clay-Working Industries in the United States in 1914. By Jefferson Middleton. P. 94.

Production of Abrasive Materials in 1914. By Frank J. Katz. P. 20.

Production of Magnesite in 1914. By Charles G. Yale and Hoyt S. Gale. P. 18.

Production of Asphalt, Related Bitumens, and Bituminous Rock in 1914. By John D. Northrop. P. 26.

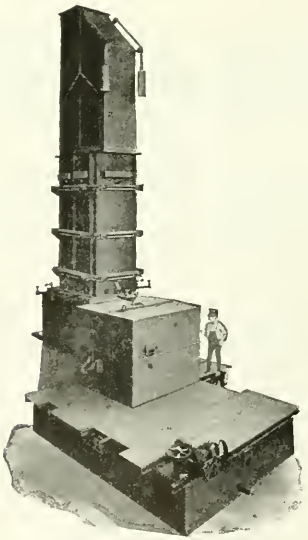
NEW MACHINES AND DEVICES

Information based on letters and catalogues from manufacturers.

An Improved Hot-Blast Furnace

This hot-blast furnace is a Partridge type furnace, embodying its original features, with the addition of several improvements. The principal variations from a standard lead or copper blast-furnace lie in the use of a continuous open slot or aperture in place of circular tuyeres at regular intervals, and an arrangement for pre-heating the blast by direct contact with the molten slag.

The furnace consists of a rectangular water-jacketed shaft, a removable crucible resting on a jack-plate, a forehearth enclosed in a chamber connected on one side to the crucible chamber, and on the other to the slag-box, which contains a rotating cast-iron pan. The space between the bottom of the



THE IMPROVED HOT-BLAST FURNACE.

jackets and top of crucible constitutes the tuyere opening. The slag and matte flow continuously into the forebearth, where the matte settles to the bottom and is tapped at regular intervals. The slag overflows onto the rim of the pan which turns slowly beneath, spreads into a thin sheet, and is gradually cooled and solidified by the blast from the blower passing over it. It is granulated and pushed toward the centre by stationary plows attached to beams above, and finally discharged into the pit below, through an automatic device which traps the blast. The furnace is of substantial construction and designed for operation in out of the way places, and far from a base of supplies. It is built entirely of heavy sheet steel and castings, the only brick-work used being the refractory lining for the crucible and settler. The jackets are open at the top to eliminate any danger from explosion, and all joints are welded. Numerous mica peep-holes are provided for the furnace-man to inspect the working of the furnace. This furnace, it is claimed, smelts efficiently and runs 'hot' in sizes prohibitive in standard blast-furnace practice, because of the open tuyere or fusion slot, the hot-blast, and the low-blast pressure.

The advantages of operation claimed for this furnace are numerous and include the following: requires less fuel; produces a higher-grade matte; makes a minimum amount of flue-dust; permits running more silicious slags; produces cleaner slags; admits of intermittent operation; is easily transported and erected; and automatically handles and disposes of slag. The ores suitable for reduction by smelting in this furnace are gold and silver, lead, nickel and cobalt, and tin.

The construction of the furnace, it is claimed, particularly adapts itself to the prime requisite of the process, namely, a voluminous hot blast under low pressure, and when operating as a pyritic furnace, attains its highest degree of efficiency. The most satisfactory fuel is coke, when it can be obtained at reasonable cost. In the semi-arid regions of the south-western part of the United States and Mexico it is generally expensive, in which event charcoal made from scrub timber on the adjoining desert furnishes a good substitute; or small wood blocks dressed with lime to prevent their burning at the top of the shaft can be used. Crude oil has not been proved a practical blast-furnace fuel so far. The furnaces are built in sizes ranging from 5 to 100 tons' daily capacity. The furnace is manufactured by the International Smelting & Manufacturing Co., 2151 Lawrence street, Denver, Colorado, from whom full details will be furnished upon application.

A Large Electric Locomotive

Butte, Montana, people are accustomed to seeing large electric locomotives hauling long ore-trains, etc., but the arrival last week of a giant engine for the Chicago, Milwaukee & St. Paul railroad attracted considerable interest. It will operate between Three Forks and Deer Lodge. A trial run was made over the Butte, Anaconda & Pacific line, which is already electrified, the other to be ready at the end of the year. The General Electric Co., which has constructed the locomotive, has contracts for other engines, sub-stations, and line material, and with the Montana Power Co. for the construction of transmission of 133 miles of main line between Three Forks and Deer Lodge. This is the first step toward the electrification of four engine divisions extending from Harlowton, Montana, to Avery, Idaho, a distance of about 440 miles, with approximately 650 miles of track, including yards and sidings. Plans are being made to extend the electric line from Harlowton to the coast, a distance of 850 miles, should the operating results prove as satisfactory as anticipated.

A comparison of six months' steam and electric operation has shown a saving of 20% on the investment or cost of electrification; the tonnage per train increased also. The locomotive is the first to be designed for railroad work with direct current motors using 3000 volts. Some details are as follows:

Total weight, tons	284
Motors	8
Length of locomotive, feet	112
Horse-power rating, continuous, each motor	375
Horse-power rating, one hour, complete locomotive	3440
Horse-power rating, continuous, complete locomotive	3000
Trailing load capacity, 2%, tons	1250
Trailing load capacity, 1%, tons	2500

EDITORIAL

T. A. RICKARD, Editor

RUMORS OF PEACE negotiations indicate the growing financial perplexities of the belligerents.

TRADE continues to expand all over the country, the revival being accentuated by seasonal business. The West is beginning to feel the effect.

THAT $500,000,000 Anglo-French loan has been swallowed without any signs of financial dyspepsia. The world has 'money to burn' these days.

ANACONDA produced 24,900,000 pounds of copper in October. This happens to be exactly equal to the output of the Lake Superior mines during the same period.

SOME of the profits from war business ought to be diverted to the improvement and equipment of the railways, of which one-sixth, as measured in mileage, is in the hands of receivers.

DURING the three months ending September 30, the immigrants arriving in the United States numbered 85,606, as against 90,813 emigrating from the country. Thus the net loss was 5207.

IN FOUR DAYS bombardment along a 20-mile front in Champagne the French used 4,500,000 shells. That means the consumption of at least 9000 tons of copper 15,000 tons of lead, and 4000 tons of zinc.

TRANSACTIONS on the New York Stock Exchange during the month of October represented a total of 26,639,000 shares, these being the biggest dealings in any month since March 1907. As compared with October 1913, the increase last month was 7,000,000 shares.

SERVIA produces about 7000 tons of copper per annum, chiefly from the Bor mine, which is controlled by a French syndicate. This source of copper may prove useful to the Germans, although the Servians, of course, will have dismantled the mine before retreating.

LONG CREDITS are essential to business with the South American countries. There has been much talk of utilizing the opening afforded by German and British pre-occupation, but, as yet, the one notable effort to win trade in South America has been the campaign of the National City Bank of New York.

IN our issue of June 26 we mentioned the intention of the U. S. Steel Corporation to build a zinc plant at Donora. The first zinc has now been drawn, just 103 days after ground was broken for the erection of the plant. Thus work requiring usually a whole year was done in 15 weeks. The output is expected to be at full capacity, namely, 40,000 tons, by January next.

FROM BUTTE we have received an interesting letter commenting on the litigation now in progress there. It will be found under the heading of 'Special Correspondence.' By the way, the Judge in the Elm Orlu case was at one time a hoisting-engineer in this very mine. No wonder that he decided to see some of the geologic evidence underground for himself, in view of conflicting expert testimony. He also tried the Minerals Separation *v.* Butte & Superior flotation case.

WE learn, through our Mr. Charles T. Hutchinson, who has just returned from a visit to the Eastern centres of business, that the leading manufacturers of mining machinery have not diverted their energies to the making of munitions as much as is generally supposed. They are having their share of war orders, but the bulk of their output continues to be along established lines. Orders for mining and metallurgical machinery and supplies are being received to an extent not equalled since the collapse of the Nevada boom in 1907. Representative companies are working at full capacity, and even employing extra shifts to cope with new business. Their chief difficulty is to get prompt delivery of raw materials, such as brass and steel sheets. The War is benefiting them indirectly; the demand for metals in the making of munitions is stimulating the production of copper, zinc, lead, antimony, quicksilver, and a dozen minor mineral substances; this, in turn, creates a demand for the machinery and other equipment required by the miner in his operations; thus our friends the manufacturers are being kept profitably busy. It is time that this tide of prosperity flowed over and around our comrades in the mining profession; indeed, such prosperity would have been manifest before now if the disorders in Mexico had not stranded a large number of capable engineers. But there should be work for all ere long.

ELECTROLYTIC precipitation of metals from cyanide solution is a subject on which Mr. G. H. Clevenger, now Professor of Metallurgy in Stanford University, is peculiarly competent to write. We publish a lengthy abstract of an important paper by him on this subject. It is well known that the late Professor Christy of the University of California did a lot of experimental work in this direction, but it was inconclusive. Even now, after experience in various parts of

the world, as recorded by Mr. Clevenger, it cannot be said that electrolytic precipitation is likely to gain in favor. It is too costly both in equipment and operation. At the present moment some interesting trials are being made in the use of sodium, in the form of amalgam, as a precipitant for gold and silver. Experiments are being conducted at the Homestake and also in several Tonopah mills, on the initiative of Roessler & Hasslacher, the New York manufacturers of cyanide and other chemicals. Precipitation with sodium is rapid—1¼ minutes as against 70 minutes with zinc shaving—but the amount of mercury to be handled makes it expensive to install or to use, now that the price of mercury is so high. Of course, the regeneration of the cyanide is a decided advantage, as in the precipitation with aluminum. We hope to publish details at an early date. Reverting to Mr. Clevenger's paper, it will be noted that he is severely critical of precipitation with zinc-shaving; by a happy coincidence we have received a timely article on this phase of the subject by Mr. Jay A. Carpenter, of Tonopah. This will be published in an early issue.

IN the October bulletin of the Canadian Mining Institute we find a discussion, by Mr. Alfred Stansfield, of a proposal made by Mr. D. H. Browne "that all smelting plants should co-operate to establish a bureau of unpublished metallurgical research." Apparently the idea is that the various smelting companies would contribute odds and ends of information, of no particular value to themselves, as Mr. Stansfield indicates, in the hope of finding among the other rejects a hint of something useful to them. In order to make such information more generally available, Mr. Browne suggests that some engineering society, like the Canadian Mining Institute, should act as custodian, with arrangements for sending a type-written copy of any part of the records to any person particularly interested. Whereupon Mr. Stansfield comes forward with the suggestion of selecting specialists to investigate the experimental records for a moderate fee. All of which indicates a praiseworthy effort to save useful experience and to pass it to those whom it may help. We agree that a big amount of experimental work is squandered for lack of information concerning similar work previously done. If every metallurgist would record briefly the negative results of his research there would be much time, labor, and expense saved from year to year. At the present moment there are tests being made, in the flotation of complex sulphides and the leaching of copper ores, for example, that traverse ground already pioneered, but concerning which nothing has been published. Secrecy, due partly to modesty, partly to meanness, is a bar to progress, but, thank Heaven! there is less of it than there used to be. The big men in the profession are generous givers of information to their fellows. Secretiveness works both ways; so does expansiveness. The best way of getting information is to begin by giving it. After all, 97½% of what any of us know came to us without payment. The least we can do is to try—vainly, of course—to square the debt.

The Great Problem

We take pleasure in publishing a letter from Mr. F. H. Newell, now head of the Civil Engineering department of the University of Illinois. He writes in response to our invitation, for in a preceding issue we had asked him to tell the readers of this periodical what were the purpose and aim of the American Association of Engineers, recently organized at Chicago, with himself as the chief sponsor. We thank him for his explanation, which will be read with keen interest; but we are frank to say that it is a little disappointing as a demonstration of the need for another engineering society. In fact, we have no reason to believe that the "great problem," namely, that of causing the community at large to appreciate the engineer and his work, will be solved by the creation of another association to include all branches of engineering. We had thought that the Panama Canal had demonstrated what the engineer can do, that the tunnels under the Hudson had suggested something of the kind, that every system of electric light and water supply hinted at the engineer somewhere in the background, that every steamship and every railroad told the same story, even to the least observant. If something more is to be done to emphasize a basic fact, it might be better to found local societies, like the Engineering Society of Cleveland, so as to establish the position of the engineer in his home community, rather than attempt by the aid of another grandiose scheme to impress the nation.

While not holding a brief for any existing society, we are surprised to find the older organizations charged with neglecting to fulfill their proper functions. We question whether one of those functions is to act as an employment agency. Of such, there are many. Some scheme of insurance against unemployment might be undertaken—by an insurance company. That could only be done, like the employment agency, on a business basis and on distinctly commercial lines, something quite apart from a professional society. However, we like the spirit of Mr. Newell and his friends. They want to do something for their fellows. In the last paragraph of his letter, Mr. Newell suggests the bringing together of the younger men, with a view to a common inspiration, excluding "the relatively cold and unsympathetic body of men who have been notable in engineering work." Surely he does a grave injustice to a large number of his fellow engineers, even to his contemporaries. On the contrary, we believe that steps should be taken to bring the old and the young, the experienced and the inexperienced, into closer touch. If our engineering societies devoted less time to the reading of dry papers and the desultory discussion of arid technology; if they devoted their periodic assemblings to the discussion of the very topics mentioned by Mr. Newell, namely, the engineer's place in the social organism, his duty in the community, his work in the world; and if this were accompanied by round-table talks between the veterans and the juniors, then something useful might be done. Let the young men tell their seniors some of those ideals of conduct

that become dimmed in the dust of daily life, and, in exchange, let the older fellows transmit their experience so that the younger may start life at a better advantage. To obtain experience without the sacrifice of ideals, that is the "great problem."

Applied Geology

The efforts of the geologist to guide the footsteps of the miner in his underground search for ore have usually come, like individual experience in life, too late to be used profitably. Belated post-mortems on particular mines are common enough, but they are rarely applicable to other mines, so that to the engineer a great deal of interesting investigation seems too academic in character to be of practical use. Yet each correlation of cause and effect is of immense value; every time the local distribution of ore can be proved to have been modified by definite structural relations, or enrichment can be traced to the agency of definite chemical reactions, we move a step toward the realization of the economic geologist's aim, namely, the ability to state where ore is likely to be found. Usually, however, the scientific enquiry begins when the mine is worked out or in trouble. Our readers will remember how the Waihi mine, in New Zealand, came to grief suddenly in 1910. This property was rated a short time previously as one of the great gold mines of the world, for it had produced $52,317,000 worth of gold and distributed $22,201,940 in dividends. It was owned by an English company of 500,000 shares. These shares fell from $50 to $17.50 in the course of 12 months, marking a depreciation of 16½ million dollars, none of which has been recovered. The system of veins that had yielded plenty of rich ore down to about 1000 feet below the surface suddenly became poor. To explain this unfortunate development, first, there came a report from Mr. R. E. Williams, who is no geologist, but a capable superintendent. He imputed the impoverishment to a change of rock, to "a soft decomposed country-rock, similar to that found near the surface." This was a reference to the soft weathered rhyolite, which, in the Waihi district, overlies the flows of andesite constituting the prevailing country-rock. In the adjacent mine, called the Grand Junction, the Waihi veins do not begin to be productive until below 500 feet, for at that horizon the veins penetrate the andesite. However, the report of Mr. Williams was not adequate to the occasion, so Mr. G. A. Richard, at that time manager of the famous Mount Morgan mine, was engaged to make an investigation. He also was more distinguished as a good manager than a specialist in economic geology, but any lack of experience in such matters was obscured by a liberal use of scientific terms, for his conclusion was that the impoverishment might be due to "a zone occurring between hydro-genetic and pneumato-genetic ore." Even this did not comfort the shareholders. That was in February 1911. Meanwhile the New Zealand Geological Survey had been preparing a bulletin on the geology of the Waihi goldfield. The examination had been commenced by Messrs. J. Mackintosh Bell and Colin Fraser in August 1910, and the staff of the Waihi mine had obtained an inkling of their conclusions long before the bulletin itself was issued in May 1912. In that publication Messrs. Bell and Fraser give it as their opinion that "a fairly large boss of dacite of rather irregular shape has intruded an earlier-formed complex of rudely bedded dacitic lava-flows." It was suggested that the veins are productive only in this intrusive dacite. That, if true, would be a geologic inference of immediate practical value. If the geologist cannot tell the miner where he is likely to find ore, it is something to the good if the geologist can tell him where he is certain to find none. In such case it would become a question of confining search to the dacite, which, unfortunately, is constricted in depth, without any compensating concentration of richness in the veins. Since the official report was made, we have heard nothing more concerning the Waihi, which, as a gold mine, continues to decline in importance; but its neighbor, the Grand Junction, is being developed with a courage not abashed by scientific dicta concerning the deeper penetration of the veins into an uncongenial terrain. The geologic discussion, moreover, is not closed. Mr. Arthur Jarman has been making a careful examination of the local geology, as illustrated in the Grand Junction workings, and is able now to come forward with a flat rebuttal of the Bell-Fraser hypothesis. In a paper just published by the Institution of Mining and Metallurgy, Mr. Jarman, who is assistant-manager of the mine in question and formerly was professor of mining engineering in University College, Auckland, gives ample evidence to show that the supposed intrusive dacite is "identical and continuous with" the bedded dacite. He disproves the massive character of the former by finding carbonaceous partings and flow-structure in the very heart of the supposed boss of dacite; in short, he concludes that ore "may reasonably be expected to continue beyond the limits of the supposed intrusion." For that relief the miner at Waihi will give him much thanks. No definite reason for abandoning exploratory work along the veins has been established. But we may conclude that certain of the dacitic flows afford a specially favorable wall-rock; therefore the delineation and tracing of these flows will be the next task of the geologist. Such association of richness in a vein with the character of the wall-rock is not uncommon. For instance, we may quote the mines in the andesitic breccia of the San Juan region, in Colorado, where good stopes coincide with those parts of the vein that penetrate a particular layer, or succession of layers, of breccia, usually finer-grained than the rest. Where, at Waihi, such favorable beds are traced on their dip, there will be a favorable chance of finding ore even in ground deeper than any existing workings, for as yet the mining operations in this district have only penetrated a thousand feet, so that they have not yet reached a stage that can be called 'deep,' as compared with other productive localities. Moreover, oxidation extends to 800 feet below the surface and the ground is full of water on the bottom levels. It remains to follow the clue given

by Mr. Jarman, to whom not only the Grand Junction company, but all the operators in that part of New Zealand, are under pleasant obligations for a practical hint likely to facilitate the search for ore.

Sampling on A Big Scale

In this issue we publish a description, by Mr. Downie D. Muir, Jr., of the method adopted in the sampling of the Ebner mine, near Juneau, Alaska. This is interesting as illustrating the practice evolved for the ascertainment of the gold contents of the enormous masses of low-grade ore found in the big lode now famous by reason of the large-scale operations of the Gastineau and Juneau mines, both of which owe their existence to the pioneer work done in the old Perseverance mine by Messrs. Arthur L. Pearse and J. R. Mitchell. In order to take samples intelligently it is necessary to have some idea both of the structure of the lode itself and of the distribution of its metal contents. The lode-channel in question consists of a broad band of black slate, steeply inclined, bordered by diabase on the hanging-wall side and by schist on the foot-wall. The slate is traversed by numerous small and irregular veins of quartz impregnated with metallic sulphides, chiefly pyrite and galena, associated with particles of native gold, both fine and coarse. The lode, therefore, belongs to the 'stringer-lead' type, resembling that of the Treadwell mine. In both cases dikes of diorite intrude into the lode-channel and appear to modify the distribution of the gold. On the whole, therefore, the structure is complicated, if not confused, in detail, although the net result is to offer a big width of quartz-veined rock sufficiently rich in gold to become the object of profitable mining operations. Obviously, that part of the lode is 'ore' which contains enough gold to be mined and milled at a profit; like all sagacious mining the operations become selective; the paramount question is to ascertain what portions of the mass are to be extracted and what portions are to be left in place. Ordinary sampling, with a moil and a hammer, making a cut across the width of ore, is impracticable because the mineralized rock to be tested may be several hundred feet wide and may extend for several thousand feet in length. Beyond the bigness of the dimensions there is the greater difficulty presented by the uneven size of the gold particles, which vary from the microscopic to aggregates large enough to vitiate any ordinary sample. In this respect the Gastineau-Juneau-Ebner lode differs from the Treadwell, in which all the gold is fine. Further, we may add that while 90% of the Juneau gold is 'free-milling,' or easily amalgamable, only 50% of the gold in the Treadwell lode is thus amenable. Since the average of the ore runs from $1.50 to $2, it is plain that an error of only 25 cents per ton, equivalent to one part in 2,333,280 parts by weight of ore, becomes serious. Finally, while the particles of gold vary in size, they also vary in their distance apart, to such an extent as to impair the doctrine of averages on which all sampling at regular intervals is based. Thus the experienced engineer does not delay in concluding that ordinary sampling is hopeless as a means of arriving at an estimate of the yield to be obtained in the course of regular milling operations on a scale of over a million tons per annum.

Speaking generally, the lower the grade of an ore the larger the sample required to ascertain its contents. Concurrently, the less regular the distribution of the metal-contents the larger and more numerous the samples should be. In a broad way, the sampling should reproduce, as nearly as possible, the conditions under which the ore will be mined. Hence it has become customary to supplement the sampling of large bodies of low-grade ore by actual milling or concentrating in a trial plant capable of treating lots of ore broken in the mine under the conditions approximating those of future operations. Small stamp-mills have been built or leased for such a purpose; at Juneau trial-runs on the usual diminutive scale have been deemed inappropriate to the immensity of the work in hand. The Gastineau and the Juneau companies used old mills ranging in size from 30 to 100 stamps in their systematic sampling of the big lode. In both cases, of course, the equipment included the proportionate concentrating plant. In sampling the Ebner mine, a 5-stamp battery was used, supplemented by an amalgamating-barrel, a settling-pan, and a Wilfley table. No effort was made to elaborate the metallurgical treatment, the main point was to crush bulk ore and to find out first how much gold it contained and then what proportion of that gold was readily amalgamable. The description shows that great care was taken to obtain accurate samples at various stages of the milling, employing automatic devices and checks of various kinds, all of which are explained in detail by Mr. Muir. In developing the mine for the purpose of a thorough examination, the ground was sampled at intervals in the ordinary way wherever the indications were favorable; when a cross-cut passed into ore, a bulk-sample for the mill was obtained by making a cut 3½ feet deep and removing a slab of that thickness the full height of the cross-cut for a length of 12 feet; this sample was broken and removed before the next one was taken. The work of testing, of course, was aided by the knowledge of the lode previously obtained in the neighboring mines. Indeed, the most reliable sample yet taken was the 500,000 tons of ore mined and milled from the Perseverance by Mr. Mitchell. Since then the Alaska-Gastineau, mining to a bigger width, has undertaken to exploit lower-grade ore on a much bigger scale, at a lower cost and a smaller profit, in proportion. It yet remains to be determined what is the economic limit, having regard not only to the operating cost but the factor of time, as applied to the redemption of capital. In enterprises of this character it is necessary to spend millions of money in order to extract millions in gold; there comes a time when the cost of money is a fatal addition to the cost of mining; both must be included in arriving at the final profit, which is the difference between the total value of the gold produced and the total cost of winning it from the ground.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Flotation in Australia

The Editor:

Sir—With regard to Mr. Edward H. Shackell's letter in your issue of the 23rd inst., taking exception to my statements in connecting with the history of the De Bavay process, as reported in my article, published in your paper of July 17, I may state that the account of Mr. de Bavay's invention given in the article was to the best of my memory as related by him to me.

The final success of the plant by the installation of cone-separators was generally understoood due to the manager of the company, Mr. Gepp. Certainly this method was tried and discarded by Mr. de Bavay while I was with the company. However, if my description was in error, I certainly regret it, as I had no other intention than to give a correct account.

Referring to the personal part of Mr. Shackel's letter, I may point out that there are generally two sides to these matters, and my own experience was no exception. Though manager of the company I was not permitted to manage, and intimated emphatically to the Chairman of Directors that continuance of such arrangement was not agreeable to me. My resignation—as per copy attached—followed.

C. S. Galbraith.

Keddie, California, October 25.

American Association of Engineers

The Editor:

Sir—In your editorial you kindly suggest that I tell your readers what is the "great problem" that is to be solved, and you ask, "Is it co-operation with a view to fraternal benefits, that is, insurance against ill health or lack of work?" In part it is, but in a larger part the great problem is that of dispelling ignorance and of diffusing information among the thinking people, and especially the taxpayers, as to what the engineer can do and is doing for the benefit of mankind. If there existed a full appreciation of this matter, there would be little said as to the necessity of an organization for insurance or any other purpose. In other words, the great obstacle to progress by the engineer in improving the welfare of mankind, and incidentally his own, lies in the slowness with which correct information is diffused among the people who will most be benefited.

Growing out of this lack of knowledge arises the condition that today a considerable portion of the engineering profession is unemployed or its services are not being utilized in the most effective manner. The great problem as it relates to employment would not be a problem if there were full appreciation of the fact that every day these men are out of employment there is a direct loss not so much to them as to the entire community. A result of this lack of employment is, for example, the delay or lack of construction of sanitary systems, causing uncounted and unnecessary deaths or days lost in sickness. One of the ramifications of the great question is how to diffuse information to the public, how to tell the facts to the man who pays the bill in a way that he and the public can and will assimilate the facts and make them part of their consciousness.

It is true that we have a large and increasing number of high-grade technical publications, but these are read mainly by the men who are already well informed on fundamentals. The great body of citizens does not see nor know of these publications nor grasp the significance of the developments that may be made. The engineering societies are publishing tons of literature, all of which, however, is addressed to the members and is not within the range of the ordinary reader. Little, if any, effort is being made to build up systematically a broad knowledge of what is being accomplished. In comparison with efforts being made in other directions, the engineering profession as a whole cannot view with pride the lack of modern up-to-date or scientific effort to diffuse information among the great mass of the people who are directly or indirectly benefited by engineering works.

As a specific example of what may be done, I may cite the case of the Engineering Society of Cleveland, Ohio. Only a few years ago it was practically a moribund organization. A few enthusiastic men determined to try to make it take its proper place in public esteem. They worked hard and learned many things of value to themselves and to others. Without discussing their struggles, it may be said today that the citizens of Cleveland know and respect this society as a force for good in the community. It has done more to elevate the whole engineering body in popular esteem than any other one effort made in recent years. Success was obtained largely through taking the public into its confidence. With the helpful aid and advice of certain of the local editors the society succeeded in giving out to the public of Cleveland—in short readable statements—a few elementary facts as to what the engineer does and can do for the community. The public responds quickly to such information when given in the proper spirit and obviously without desire for personal advertising.

What has been done at Cleveland can and should be

done in every centre of population. It is, however, doubly difficult to do this in many localities because of the fact that the existing engineering organizations are under the control of men once young and aggressive but now tending to ultra-conservative habits of thought. They do not see that times have changed and that there are new matters continually arising. They have clearly in mind the saying: "Old men for counsel," but they often forget that counsel without action has little value or perhaps are unwilling to observe the rest of the proverb: "Young men for action."

It is to be regretted that it is sometimes necessary to organize new associations to do the work which might better be done by existing bodies. These new associations may accomplish their purpose by stirring up the older societies and bringing them to a larger appreciation of new needs.

In reply to your question "What is the new association going to do for the profession?" the reply may be given, that this particular association hopes to do those things which the older organizations "passed by on the other side" namely, diffuse information to the reading public, and bring together the younger men of the engineering profession who do not see any reason why they should join the older societies. It hopes to establish for the profession a broad, thoroughly honest method of seeking employment, one which may be developed from a scientific study of the whole subject. It is trying to bring together the coming men, the men who have yet to make their reputations, and who will find through association with their fellows an inspiration which is lacking in the relatively cold and unsympathetic body of men who have been notable in engineering work. Whether it succeeds or not, it will at least have made its contribution toward a better fellowship and a better understanding of the problems which surround the life of the young struggling engineer.

F. H. Newell.

Urbana, Ill., October 15.

The Editor:

Sir—Relative to Mr. Newell's championship of the body of engineers in the country, there is no doubt that the American public fails to appreciate engineers. They are not appointed on public boards and committees even in cases where engineering advice is sadly needed; instead, lawyers, politicians, and 'reformers' are selected to do things of which they know nothing and never will. From the smallest village council to the Federal government, there is a lack of proportionate representation of engineers in public appointments and advisory boards. More to the point perhaps is the incomplete appreciation of engineers by business firms and corporations. Commercial bodies fail to comprehend the immense possibilities of the employment of technical men, and do not see that engineering graduates can be broadened into efficient officials of unlimited grasp. The amazing growth of Germany's industries during the last 25 years was in large measure the result of appreciation and utilization of technically trained workers. Instead of considering engineers as men apart from ordinary use and behoof, industrial organizations should cultivate, encourage, and, if necessary, educate technical graduates along lines mutually beneficial to both sides. Unlimited possibilities exist in this direction, and the sooner American businessmen realize it the better for them—and the engineers.

There is a possibility, perhaps, that the engineer tends to resist being drawn out; he is inclined to be narrow, aloof, superior, and cynical, scorning self-advertisement and publicity, for the reason that public life and commercial routine present unlovely aspects to him, full of inconsistencies that he does not understand. He prefers to have things come to him rather than seek recognition in a public way, although he will work untiringly at a problem when once started and encouraged. Yet to a considerable degree this detachment of the engineer is "all a sort of shell," he knows, and we know, that he is one of the most sympathetic and human of men at heart.

If Mr. Newell can arouse the engineers to commingle with the public, and the public to consider the engineer as not only a machine—but also a citizen—the result will be mutually beneficial and of signal importance to the entire country. However, some doubt may exist as to whether a gigantic association would achieve this desirable result. Big associations and scattered organizations are bound to involve a lot of misplaced enthusiasm and a stupendous array of misunderstandings; withal they are extraordinarily difficult to administer satisfactorily. The engineer is primarily an individualist, and is liable to distrust huge organizations of his fellows; he recognizes that a lot of nonsense, injustice, and superficiality are bound to be present.

Undoubtedly there is need for a man of Mr. Newell's standing to start a campaign of justice for the engineer. If nothing else results, the advertising and educational effect on the general public, by calling attention to an important profession, hitherto unappreciated in anything like its due proportion will be salutary and welcome. Certainly, too, it is the young struggling engineer who should be assisted by engineering societies—the older successful men do not require help.

P. B. McDonald.

Berkeley, November 3.

Mine Accidents

The Editor:

Sir—In reference to your article in the issue of October 9 regarding mine accidents and their causes, I would like to state that my own experience indicates that 99 out of every 100 times the management is to blame. As to a miner coming down a ladder with powder, caps, and fuse in addition to his candle, have you ever tried it yourself? also what provision has the management made for carrying these things? As for the caps reposing on the box of powder, was there any place provided for the caps out of harm's way, except to lay them on the floor where anyone might come and knock, kick, or otherwise disturb them? Now, I believe that if managers were to go into the workings as a miner under the same condi-

tions as the actual miner, they would soon find what makes irresponsible laborers and miners, and why supposedly unnecessary risks are taken. At one time I had charge of some work under a chief of good repute, which in most respects he deserved, but he would not spend the money necessary to make the handling of powder convenient or safe. There was no satisfactory method of thawing it, and no one to look after caring for it properly. I kept at him to build a small place for thawing powder within a reasonable distance, which in this country is not closer than 150 ft. of the mouth of any tunnel. At last permission was given and the place built, but do you suppose he would put any kind of heating appliance in it? Nothing doing; the same old method: thaw it the easiest and quickest way possible regardless of accidents. Now I don't say that all managers are like this, but I will say that being chief engineer or manager is a different thing from being a miner. In most cases a miner could not manage a property; but how many engineers can actually do the mining? Can they recognize a good hammer-man, or can they take hold of tools and do the work? If they cannot, then it is hard for them to see where and why the miner is careless. Again, under such conditions a man who carries his powder on his person to keep it thawed and takes all kinds of chances, does more work, and gets ahead better than the man that will not do these things. What is the outcome? The careful man gets fired, the management showing the other miners that the same will happen to them if they don't do ditto. Now this is not the condition under all managements, but when a good management gets miners that have had a schooling of the other class, the accident risk is the same.

J. W. D.

Mirror, Alberta, October 15.

Gas Engines and Altitude

The Editor:

Sir—'Concentrates' in the issue of October 23 says, "Altitude is not a factor of gas or gasoline engine," etc. This is wrong. Altitude is an important factor in an internal-combustion engine. The capacity of any internal-combustion cylinder is in direct proportion to the amount of oxygen that can be taken into the cylinder. The fuel is but secondary, being enough to combine properly with the oxygen. The higher the altitude, the less the weight of oxygen per cubic foot of air, and the lower the possible horse-power that can be developed in any particular engine. In bids submitted to me for some large Diesel multi-cylinder engines, they were rated at 2250 b.-hp. at sea-level, and at 1900 b.-hp. at Miami, Arizona, the approximate altitude being 3700 ft. It has been proposed that at high altitudes the intake air for big Diesel motors be compressed by Root blowers, or that the cylinders of the motors be increased in diameter.

J. Parke Channing.

Miami, Arizona, October 25.

[Mr. D. W. Brunton writes as follows: "The 'Concentrate' is strictly correct, but I am afraid it might convey the impression to a careless reader that a gas or gasoline engine would develop the same power at high altitude as at low, which is not the case. The density of the charge in a cylinder at the end of the intake stroke cannot be greater than the atmospheric density outside; consequently, although the gasoline engine works equally well at high or low altitudes, as you state, it does not receive as heavy a charge at high altitudes as at low, and therefore the power developed is correspondingly less."

A. T. Kasley, chief engineer of the S. & G. E. department of the Westinghouse Machine Co., East Pittsburg, says: "We have found by experience that this is not true [that altitude is not a factor of gas or gasoline engine operation.—Editor.] The engine depends upon the expansive force of a mixture of air and gas or gasoline, and if the air is rare, due to altitude, it seriously affects the possible power that can be obtained from an engine. At an altitude of 6000 ft., an engine will only develop a little over two-thirds as much power as it will at sea-level."

In *The Gas Engine*, H. H. Clark writes as follows: "For two years I have been running a Foos gas-engine at 10,000-ft. elevation in Mono county, California. The engine is used for hoisting gold ore from a 200-ft. shaft, raising a 700-lb. bucket in 67 seconds; it is a 7-hp. engine, and has worked so satisfactorily that I purchased a smaller one to pump water at Calipatria, Imperial county, at a point 198 ft. below sea-level. I see no difference in the working of the two engines, except that I have to give the higher one all the air possible, which I did by taking out the air-pipe entirely and drilling the hole larger."—Editor.]

Woven Wire for Revetment

The Editor:

Sir—In your issue of July 10, 1915, in the article entitled 'A Novel Debris Dam,' the statement is made that this application of woven wire for a revetment was being made for the first time. This is a mistake, as the author and designer can see by reference to the files in the Patent Office, Washington, D. C. of 1906, for I patented such application at that time and have used it in a great many different forms since.

Some years ago I used it in the construction of a dam near Roswell, in New Mexico, in connection with irrigation work; in 1905 and 1906 in Park county, Colorado, in hydraulic mining as a revetment to protect wasteways; in 1914 in Nigeria, Africa, on dam construction and to protect road-ways across drifts against wash-outs.

It is in use in Spain, near Leon, on a tributary of the river Sill, as a protection against erosion of banks and to protect bridge-piers.

Persons wanting to use this can make arrangements with H. G. Peake, of the Union Construction Co., 604 Mission St., San Francisco.

W. E. Thorne.

Bodaibo, Siberia, September 1.

Sinking the Woodbury Shaft, Michigan

By J. M. BROAN

[In rock-drilling, shaft-sinking, and blasting practice, the Lake Superior copper and iron regions are taking the lead. The following description of sinking a large vertical shaft written by a mining engineer at the Newport mine (often mentioned as the largest underground iron mine in Michigan) is interesting for the following points:

1. Two 'headers' were used in the shaft for distributing compressed air to the drills, each header being able to supply 7 plugger-drills and a blow-pipe. A header is a convenient device for conducting compressed air from the air-main to the rock-drills which are hung on the header when not in use; the whole outfit can be lowered and raised with speed and ease.

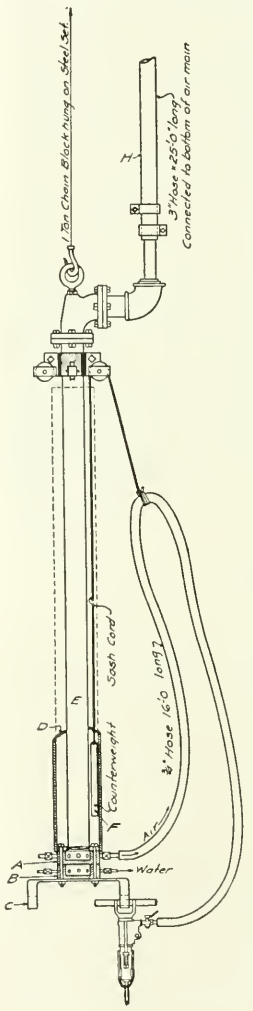
2. Jack-hammer drills, 12 in number, with $\frac{7}{8}$-in. hollow hexagon steel up to 10 ft. long (an unusual length in sinking) were employed. The bit on the starters was $2\frac{1}{4}$ in., while all other bits were reduced by $\frac{1}{8}$-in. diameter for successive lengths. For granite, Carr bits gave satisfaction, but mechanical drill-pullers had to be contrived for freeing stuck drills.

3. In blasting, two or three sticks of 100% blasting gelatine were placed in the bottom of the hole, then 80% strength for the remainder, except a single cartridge of 60% for containing the detonator. An average of $26\frac{1}{2}$ lb. of explosives was consumed per foot of shaft.

4. The shaft was 'timbered' with steel sets.—Editor.]

*The Woodbury shaft, being sunk by the Newport Mining Co. at Ironwood, Michigan, is situated 100 ft. from the contact between the iron-bearing formation and the underlying strata. The shaft is vertical, with its length at right angles to the strike of the formation. The over-all dimensions are 13 ft. 1 in. by 21 ft. 1 in., having six compartments, which will accommodate 2 skips, 2 cages, 1 ladder-way, and piping. The first 100 ft. of sinking was in quartzite; from 100 to 715 ft. in depth there were alternate gray and red slates and quartzite, below which is granite. The temporary head-frame is 60 ft. high, with the trestle so arranged that it is possible to hoist rock in any of the compartments and dispose of it by means of a haulage-motor and car to a common stockpile. During the sinking of the first 700 ft., the hoisting was done in three compartments by means of a single-drum hoist, operated by a 50-hp. motor and a double-drum hoist, operated by a 70-hp. motor. While sinking this portion of the shaft, a duplex horizontal steam-hoist was being installed by the Allis-Chalmers Co. for handling the cages and by July this was used to operate a bucket in the fourth compartment.

Three belt-driven compressors, of the Ingersoll-Rand Imperial type No. 10, each driven by a 50-hp. motor, furnish air at 90 to 100-lb. pressure to 12 jack-hammer drills. The air-line is a 6-in. wrought-iron pipe for permanent use. The equipment is in some respects different from ordinary practice. Two 'headers' are used for distributing air to the drills, each of which will accommodate 7 jack-hammers and 1 blow-pipe. When not in use the 'headers' are hung to one side in the head-frame and can be easily lowered by means of a sling beneath the bucket; while in use they hang on a small chain-block fastened to the bottom shaft-set. When ready to drill, all that is necessary is to remove the jack-hammer from the hook and pull downward, the counter-weight keeping the slack hose out of the way while drilling. One of these headers can be taken from its position on surface and placed on the chain-block below ready for drilling in less than five minutes, only one connection being necessary. In the softer slate, water-tube pistons were used in the drills and air blown through in place of water. Later, when drilling in the granite, the drilling speed was not as great and it was found that sufficient air could be supplied through the ordinary piston to clear the choppings from the drill. The steel, which is $\frac{7}{8}$-in. diameter, hollow hexagon, is made into lengths varying by 1-ft. changes from 12 in. to 10 ft., with a $\frac{1}{8}$-in. difference in gauge for each drill; the first bit being $2\frac{1}{4}$-inch.



HEADER, SHOWING DRILL HUNG ON LOWER PART.

Until the granite was reached, the four-point or cross-

*Abstract of paper read before the Lake Superior Mining Institute in 1915.

bit was used, but the wear on the gauge became such as to warrant a change. It was then that the Carr bit was tried. In the stratified rocks many difficulties were caused by fitchered holes and stuck drills. Rather than abandon a hole, much time was spent in freeing a drill, so that necessity led to the devising of two mechanical drill-pullers. In case only a short portion of the steel emerged, a long goose-neck was used, while if two or more feet of the drill remained out of the hole, a shorter puller could be applied. In either case an inverted jack-hammer drill supplied the power necessary to extract the drill. In the soft slate, 10-ft. drills were used with little difficulty and cuts measuring 9 ft. were blasted successfully. In the slate about 470 ft. of drilling per cut was required, which could be completed in four or five hours. In the quartzite, dike, and granite the gauge on the steel would not hold up long enough to permit the use of any drill over 8 ft. long.

In these hard rocks about 425 ft. of drilling is necessary, which can be done in seven or eight hours. When the shaft was started, Du Pont crescent, double tape, and triple tape fuses were tried and it was found that while the double and triple tape fuses were more impervious to water, they were too brittle when exposed to air and water, and unless handled with great care would break the powder-train. Crescent fuse, however, was found to be sufficiently waterproof for use here, as it is seldom that a fuse is exposed to water for more than 15 minutes before ignition. Crescent fuse is more pliable and can stand abuse. All exploders were made with fuse of the same length, which, when the holes had been charged, were cut so as to fire them in the order desired. The ends of the fuse were then placed in a paste-board box containing a small amount of black powder. An electric fusee ignited this powder, which, in turn, lighted all the fuse simultaneously. For convenience and saving of fuse, several boxes were employed, thus requiring shorter fuse than if a single box was placed in the centre of the shaft. In each cut, 450 ft. of fuse and ½-lb. of black powder were used. This gave off such a large quantity of fume that as depth was attained Du Pont electric blasting-caps and electric delay-fuse igniters were introduced; these required less care in handling and gave satisfactory results. To regulate the time of exploding of a detonator, all that is necessary is to make the fuse of different lengths. The maximum length manufactured is 12 in., of which ¾ inch is inside the casing, leaving 11¼ in. to be divided among the different delays desired. In several preliminary tests it was found that a ¾-in. delay was a minimum that would give positive results; if cut shorter than this the holes are apt to explode out of order on account of inaccuracies in cutting and also on account of the 10% variation in the burning speed of all fuse. On the other end of the fuse a No. 8 cap is crimped. The joints where the fuse enter the brass casing on one end and the cap on the other, are both bound with friction-tape, the former having been dipped in melted roofing-cement and the latter greased, to insure a positive resistance to water. The detonator is placed in a cartridge of 60% nitro-glycerine dynamite and the shell tied with a string securing the joint which is also well greased.

Since the steel used is only ⅞-in. diam., the bottom of a deep hole is very small and cannot contain sufficient explosive to break the burden in a satisfactory manner. To offset this disadvantage without drilling more holes, two or three sticks of 100% blasting gelatine is placed in the bottom of each hole. The remainder of the charge, with the exception of the cartridge containing the detonator, is 80% blasting gelatine. Experiments by the Du Pont Co. have shown that 60% nitro-glycerine gives a maximum efficiency for speeding the action of a charge, and for this reason a single cartridge of this strength is used to contain the detonator. It is placed as near the

DRILL-PULLERS.

top of the charge as is considered safe from being cut off by the breaking of an adjacent hole. Cartridges of sand are used for tamping. An average of 26½ lb. of explosive per foot of shaft has been used in the first 800 ft., or about 1 pound for every 13 cu. ft. of excavation.

In preparing a blast, the leads of No. 20 copper wire are laid over the centre of the portion to be blasted and the various igniters connected in parallel with them. The reason for this method of connection is to prevent a misfire in case of a single defective igniter or connection, which would cause the failure of the blast if connected in series. It is safe to figure about one ampere per path. From 30 to 35 holes is about the maximum number fired at any one time. The switch for closing the circuit is locked in a small cupboard on surface, and the key is kept by the shift-boss during the preparation of the blast. Every igniter is tested with a small galvanometer before being used. After a blast the smoke is cleared by a draft forced through a 12-in. pipe by a 7-hp. fan on surface. At first the fan was used to draw the smoke out, but by reversing the current, less time was required to clear the smoke.

During the first 700 ft. of sinking the broken rock was hoisted in three buckets, each of a capacity of 26 cu. ft.

To render the shoveling as easy as possible, steel plates were used as sollars, with considerable success. The steel sets are made of 6-in. H-sections and are hung on studdles of 3 by 5-in. angle-iron. Sets are spaced at 6-ft. centres in the slate, and 8-ft. centres in the granite. At every 100 ft. of shaft a bearing-set is placed under the set. These are supported temporarily by large spruce sprags about 12 or 15-in. diam., which will be replaced later by concrete. While in the slate the steel sets could be kept within 15 ft. of the bottom without being damaged, but in the granite if hung closer than 30 ft., blasting is liable to harm them. Guides are made of 6 by 7-in. pine, dressed, and are framed to span two 8-ft. or three 6-ft. sets. Laths for lining the shaft are made of 2-in. hardwood. These also serve as forms for concreting when sinking operations are completed. The ladders are made of $\frac{3}{8}$ by 2-in. strap-iron sides and $\frac{3}{4}$-in. iron rungs. They are long enough to reach over two 8-ft. or three 6-ft. sets, and in both cases have about 4 ft. projecting above the sollars. The sollars are made of 3-in. plank.

All lighting is by electricity. A single lamp is placed under each ladder-sollar; at the bottom of the shaft, two clusters of four lights each are hung, one below the staging to give light to the miners and one above to give light to the construction crew. An electric signal-system is used, the wires being run down the east side of the shaft beneath the ladders. By means of a jumper connected to a common return-wire, either signal-bell can be run from any sollar. The men employed in the shaft are as follows: One shaft-captain, 3 shift-bosses, 36 miners, 11 construction men, 1 electrician, 4 landers, 2 motor-men, 4 hoist-engineers, a total of 62 men. The sinking was started on March 1, 1915, and at the time of writing (July 27) is 901 ft. in depth. The maximum footage per month was 201 and the minimum 173 ft. To guard against accidents from falling fragments, hard hats, made of felt treated with resin and shellac, are furnished to the men, and no one is allowed to enter the shaft without one.

Bolivia has an area of 708,195 square miles, which is over twice the area of the Pacific Coast states of California, Oregon, and Washington; the population is 2,267,925, while La Paz, the capital, has but 82,000. With no coast and being a rough country for railroad construction, Bolivia remains to a large extent undeveloped, though its mineral wealth is undoubted. Previous to the War, its principal foreign connections were with England, Germany, France, and Belgium. In the first five months of 1915, the export of ores and metals aggregated 20,894 metric tons, compared with 19,059 metric tons during the same period in 1914 previous to the War. They were: tin, 17,055 tons; copper, 2037; bismuth, 211; wolfram, 243; antimony, 1315; silver ores, 33 tons.

Boring for oil on the island of Madagascar off the African coast is proceeding at depth. This island, a French colony, is larger in area than either France or Germany.

Mineral Output of the Philippines

The Division of Mines, Bureau of Science, at Manila, has issued its report on the mineral resources of the Territory in 1914, a review being compiled by Wallace E. Pratt. Good progress was made in gold mining. After considerable discussion, the new royalty of 1.5% on the gross output of gold, became effective on January 1, 1915. As much as 5% was proposed by the Legislature, to cover precious and semi-precious metals. Although some copper development was done, capital did not become interested to any extent. The Tellus Syndicate, of Frankfort, Germany, examined the old Santa Barbara mine at Mancayan. Reserves were estimated at 225,870 tons of 5.22%, and 150,000 tons of 1.75% copper ore. Iron-smelting in Bulacan continued normal. Coal mining remained inactive. No drilling was done in the Bondoc Peninsula oil area.

The mineral output was as follows:

Product.	1913.		1914.	
Metallic:	Quantity.	Value.	Quantity.	Value.
Iron, metric tons ...	227	₱64,471	199	₱56,274
*Silver, fine ounces ..	.....	.....	10,000	9,878
Gold, fine ounces....	42,011	1,736,724	52,235	2,349,267
Total value of metallic...		₱1,801,195		₱2,415,419
Non-metallic:				
†Clay products		₱460,000	.....	₱465,000
†Lime	11,050	102,700	11,000	100,000
‡Sand and gravel....	689,011	595,645	723,461	625,429
‡Stone	197,039	350,041	206,890	367,543
†Salt, metric tons....	19,500	575,000	20,000	590,000
Mineral waters, litres.	270,000	60,000	293,381	50,000
Total value non-metallic..		₱2,143,386		₱2,197,972
Grand total		₱3,944,581		₱4,613,391

*The gold bullion produced carries from 5 to 30% of silver as a natural alloy.

†The manufacture of this product is a household industry in a large part of the Territory; statistics are, therefore, not available, and estimates are approximate.

‡Production of the Bureau of Public Works, which is the largest single producer, estimated for 1914.

A little more than 50% of the Philippine production of gold came from quartz mining at Aroroy, Masbate, where the Colorado, Syndicate, and Keystone mines are the principal producers. The P. A. Schwab property at Aroroy also produced some gold, and other prospects have been actively developed.

Dredging is responsible for nearly 44% of the 1914 output. The principal producers among the dredging companies are all in the Paracale-Mambulao district, in Camarines province, and include the Gumaos Placer Company.

Peru has an area of 680,000 square miles, which is over four times that of the state of California, and a population of 4,500,000, while Lima, the capital, has 150,000. The national debt of the country is stated to be $6.50 per capita of population. The deposits of copper, lead, silver, oil, vanadium, and rare metals are important.

THE ELMER MINE, ALASKA.

Sampling Low-Grade Ore on a Large Scale

By DOWNIE D. MUIR, Jr.

Introductory. The ore in the Ebner mine, near Juneau, Alaska, consists of two classes; first a tough fine-grained diorite or meta-gabbro, brown in color and containing a network of quartz stringers or veinlets; second a black carbonaceous slate similar to the diorite as regards distribution of quartz. Practically the entire value of the ore is in free gold; the sulphides are less than 1% and are very low-grade. Distribution of the free gold in the ore is uneven, the content increasing with the number of quartz stringers or the amount of quartz. The gold varies in size from the finest particles to small pieces weighing a sixth of a milligram, a considerable portion also is found in flakes the size of a pinhead.

Experience in the district indicated that the best method of determining the average value of this low-grade ore was by crushing representative lots in a small stamp-mill. Since the ore averages only $2 per ton, it is obvious that an error in sampling of 25 cents represents from 25 to 33% of the margin of profit. In conjunction with development work the rock was sampled regularly until ore was encountered in the cross-cuts. A continuous cut 3½ ft. deep, the height of the cross-cut, was broken from one side; for convenience the length of sampling was limited to 12 ft. This was sent to the mill prior to breaking the next cut. By using care in the alignment of the drill-holes the cut amounted to 2½ tons per foot. The assays of these separate 12-ft. sections were then combined to secure the average over any particular section.

The mill erected at the start contained a battery of five 850-lb. stamps and the flow-sheet was simple. The ore from the mine passed over track-scales and a 1½-in. grizzly, the oversize went to a gyratory crusher and joined the undersize in the ore-bins, where the moisture-samples were taken. The battery-screen had 40-mesh diagonal slots 0.5 in. long and 0.025 in. wide. The pulp from the battery passed over silver-plated amalgamating plates into amalgam-traps and thence into the tailing-launder. The checks adopted in the sample-mill did not

differ materially from those used in ordinary practice of milling free-gold ores, namely, that the gold in the tailing plus the recovery from the plates shall approximately equal the assay of the splash from the battery. Samples of the battery-splash were taken at regular intervals by hand just below the lip of the mortar, and the tailing samples by an automatic sampler, the mill operating on a 24-hour cycle.

At the outset satisfactory checks were not obtained; naturally, a discrepancy that might have been acceptable with a $15 ore was prohibitive in this case. Several factors entered into this discrepancy such as absorption of gold on new plates, impracticability of removing all the accumulated amalgam at the completion of each test, scouring action of the pulp when the ore dropped in grade, and the tendency of the slime to form a scum on the plates, preventing amalgamation. The controlling factor, however, proved to be the type of battery-screen used. The length of the diagonal slot allowed many flakes of gold to pass, rendering intermittent hand-sampling useless, as well as preventing mixing and rolling of the sample from producing a homogeneous sample from which representative assay-pulps could be cut. Numerous screen-tests confirmed this inference when it was found that with a product which had not been ground to pass 40-mesh woven-wire screens, it was impossible to cut separate assay-pulps that would check each other.

Sand Method. To prevent such error, a 40-mesh woven-wire screen was adopted with an automatic sampler for the battery-splash, eliminating the amalgamating-plates entirely. This method, termed the 'sand method,' for purposes of differentiation, is shown on the left side of the flow-sheet.

The automatic sampler, actuated by a hydraulic cylinder under a constant head, was installed just below the battery, the pulp from which was caught in a V-shaped box the same length as the mortar and 4 inches wide. A 3-in. pipe 4 in. long was set flush, at the apex of the V, with the inside of the box, and in a vertical position, discharging the pulp from the battery into a 12-in. launder 2 ft. long, set on a slope of an inch per foot. The proportions of the launder, together with the slope and spiral action of the discharge from the 3 in. pipe, resulted in an even flow of pulp over the entire width of the launder. The cutter of the automatic sampler working immediately below the lip of this launder took a sample amounting to from 1 to 1.75% of the battery-feed. As the stamp-duty was 0.09 ton per hour the resulting sample weighed from 150 to 250 lb. per run of 22 hours. The remainder of the battery-discharge that passed the sampler was at first run over amalgamating plates to save such gold as would amalgamate without any great amount of attention. The amalgam recovered on the plates, however, did not enter into the sampling of the ore in any way, and they were later removed to make way for a Wilfley table used in the concentrate method.

The following screen-tests on the battery-splash show the fineness to which the ore was crushed prior to any quartering for assay-pulp.

Mesh.	Percentage of weight.	Percentage of average value in product.
On 40	....	....
" 50	23.34	33.21
" 80	7.36	16.04
" 100	7.36	13.08
" 120	4.92	8.14
" 150	2.46	4.49
" 200	0.61	1.24
Through 200	49.65	19.49
Lost in screening	4.30	4.29
Total	100.00	99.98

Note: The percentage of weight lost in screening is assumed to have the average value of the sample.

The battery-splash sample was dried thoroughly in a drier constructed for that purpose, in which it was possible to start the drying of the wet pulp at a low heat, gradually raising the temperature as the excess of moisture was evaporated, at which time all danger of loss of a portion of the sample through boiling and bubbling had passed. When dried the sample was weighed, placed on steel plates, coned and quartered to approximate 50-lb. lots, then rolled on a rubber sheet and cut to final assay-pulps of 3 to 5 lb. each by means of a Jones sampler, and subsequently ground to pass 150-mesh for assay. In the case of screening the final cut for assay through the 150-mesh screen the men in the grinding-room were provided with large sheets of white glazed paper on which all material remaining on the screen was dumped. This paper with its contents was then scorified; in the event of metallics being found, their value was proportioned to the weight of pulp from which they had been derived and this was added to the assay of the pulp. The result was accepted as the average assay of the battery-splash; it marked the completion of the first stage of the method.

The reject from the battery-splash sample was charged with about 40% by weight of water into a 3½ by 2-ft. amalgamating-barrel filled to nearly the centre line with flint pebbles. The barrel was revolved at from 50 to 60 r.p.m. for 18 hr. at the expiration of which time an excess of mercury was added, an ounce of mercury to 10 lb. of dry pulp giving the best results. The pulp was allowed two hours of additional grinding in contact with the mercury before being discharged by means of a steel launder into a 3-ft. settling-pan. Longer grinding with more mercury resulted in excessive flouring, which rendered difficult the subsequent panning for its recovery, thus tending to decrease rather than increase the recovery by amalgamation.

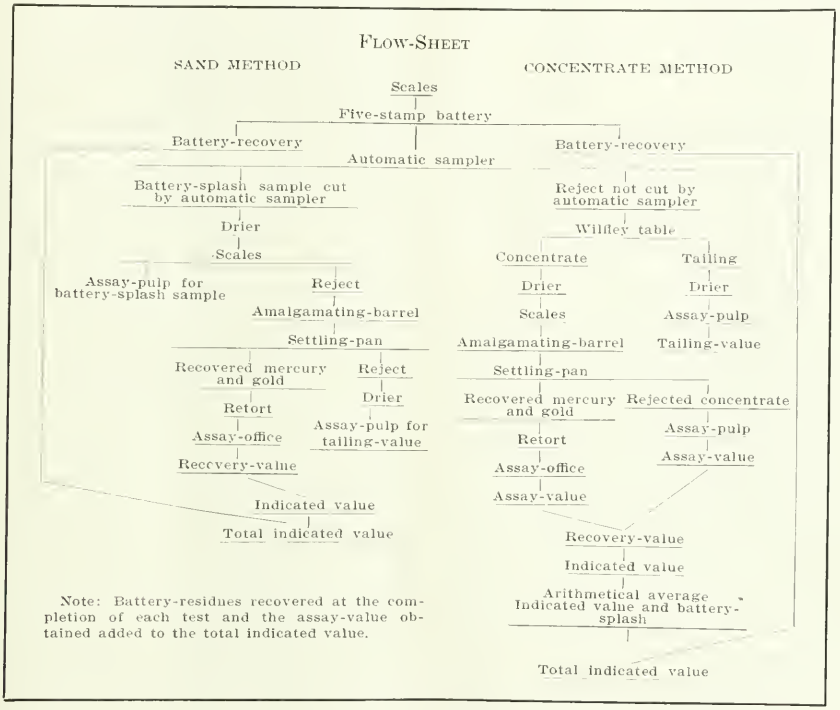
For this kind of inside amalgamation, where the barrel must be entirely discharged and cleaned once every day (or after each sample), it is best to use a barrel having a readily removable head. Small blow-holes, which the usual casting is apt to contain, are exposed from time to time in the inner surface of the barrel as the grinding proceeds and, acting as an amalgam trap, fill with hard

amalgam. The inability to inspect inside of the barrel satisfactorily through the usual small hand-hole may cause one or more of these amalgam-filled cavities to be overlooked, with a resulting salting of the following sample, and reduction in value of the sample under treatment. The effectiveness of a salting, however small it may be, is obvious when it is considered that the value of the gold recovered from a 150-lb. sample in this manner is multiplied approximately 13 times to indicate the gold that would be recovered from a ton of such ore.

The fineness to which the sample was reduced after 20 hours of treatment in the barrel is shown by the following screen-test:

Mesh.		Percentage of weight.	Mesh.		Percentage of weight.
On	80.....	0.8	On	200.....	3.55
"	120.....	7.1	Through	200.....	88.30
"	150.....	0.0			
			Total	.....	99.75

Following the treatment in the barrel, the pulp was agitated in the settling-pan for two hours by means of a mechanical agitator, having four paddles, one fixed at each quadrant of the circle to a spindle that was revolved by gears underneath the pan. A screw adjustment permitted the raising or lowering of the paddles to any desired height above the bottom of the pan. The height of 1½ inches at 15 r.p.m. proved satisfactory for settling the mercury. At the end of this period the pulp was allowed to settle sufficiently long to siphon off a reasonable amount of the supernatant liquid. The thick pulp was drawn off to within two inches of the bottom through the side-discharge openings in the pan. The pulp remaining in the pan, containing practically all of the mercury and amalgamated gold, was then drawn off through the bottom-discharge into another tub and panned many times, recovering as much of the mercury and amalgamated gold as possible. The loss in mercury amounted to from 2½ to 5% of that originally fed to the barrel and was due to the 'flouring' and 'sickening' in the barrel. No attempt was made to eliminate this fouling through the introduction of reducing agents in the barrel or acid treatment of the mercury during the panning operations, as any small amount of gold that this mercury may have contained was accounted for in the assay of the tailing, as will be seen from the subsequent treatment of the reject from the settling-pan and panning operations.



The mercury recovered, weighing from 15 to 25 ounces, according to the weight of the sample treated, was then retorted. This proved to be a slow and tedious operation, as the large excess of mercury carrying a relatively small amount of gold made necessary a slow treatment to insure collecting of the gold in a button at the bottom of the retort. Rapid treatment under these conditions resulted in scattering the gold and leaving thin scales firmly attached to those portions of the retort from which the heat had flaked the chalk lining.

After retorting, the contents of the retort, including gold, chalk, and any foreign material such as sulphides

mixed with the mercury, were sent to the assay-office. The gold thus obtained, in proportion to the weight of the pulp from which it was recovered, represented the yield per ton. This gave the 'recovery-value' and marked the completion of the second stage of the method.

The reject from the panning of the lower two inches of pulp from the settling-pan, containing the major portion of the 2½ to 5% of mercury loss, was added to the remainder of the reject from the settling-pan. The combined pulp was dried and quartered in the same manner as the battery-splash sample to a final 3 to 5-lb. pulp for assay, the result being the 'tailing value,' marking the completion of the third stage of the method, which was also the final stage so far as this one sample was concerned.

In drying, this pulp was subjected to a heat of from 150 to 300° F. for a period of 15 to 20 hours. Although this heat was relatively low, it was apparently sufficient, considering the length of time in the drier, to volatilize the floured mercury, as no traces of this were found on the 150-mesh screen when preparing the final pulp for assay. Thus any gold that this mercury may have contained was accounted for in the tailing-assay.

Numerous quartering tests on the pulp from the barrel, after the removal of 75 to 80% of the free gold by amalgamation and from 2½ to 15% by failure to pass the battery-screen, proved conclusively that various assay-pulps cut from the entire sample would check consistently to within 2 or 3 cents per ton. Further assay-pulps, cut from a composite sample of the entire daily tailing-rejects for any one test covering a period of several days and weighing 500 to 1000 lb., checked within an average of 3.5 cents per ton (disregarding the plus or minus sign) the average calculated value of the separate tailing-samples covering the same test. By this method, after the rough points were ironed out, the tailing-value plus the recovery-value checked the battery-splash sample within 8 cents for a run of 200 tons. Later, when working smoothly, this discrepancy was reduced 4.8 cents for runs of the same tonnage.

On completion of the mill-sampling of any one section of desired width in the mine, the residue in the battery was removed and the free gold extracted by aid of an ordinary rocker. This gold was then melted, the fineness and value determined, to be apportioned to the tonnage from which it was derived. As might be expected when using such fine battery-screens, this value exceeded 10% of the total.

The battery recovery when added to the combined daily tailing-value plus combined daily recovery-value for any one test was considered as the total indicated value of the ore, provided the sum of these two checked the combined daily battery-splash sample covering the same test.

In this method it will be noticed that the recovery-value and tailing-value are based on the treatment of a very small proportion of the total tonnage milled or sampled, and, as previously stated, any error in the recovery-value is increased to a damaging extent in the final result. The fact that the recovery-value plus tailing-value checks the battery-splash cannot be accepted as proof positive that the correct value of the ore has been ascertained, unless it is conceded that the automatic sampler cuts a true and average sample from the battery-splash. In this case such was proved to be the case by subsequent work.

Concentrate Method. To prove the accuracy of the average cut by the automatic sampler we adopted the concentrate method in which the determining of the recovery-value and the tailing-value was based on the treatment of the entire tonnage milled and was run in conjunction with the sand method.

A No. 6 Wilfley table was installed on the lower floor of the mill to take the entire battery-discharge with the exception of that portion cut out by the automatic sampler as a battery-splash sample. The resulting concentrate was then dried, weighed, and the ratio of concentration determined. This was followed by charging the concentrate from the 22-hour run into an amalgamating barrel considerably larger than that used in the sand method, employing iron balls rather than flint pebbles. The quantity of water added to the charge varied; it had to be sufficient to render the resulting pulp liquid enough to permit thorough permeation by the mercury. The treatment of concentrate in the barrel was similar to the sand treatment with the exception of the amount of mercury and the time of contact, both of which were increased on account of the higher gold-content of the concentrate per unit of weight over the crude ore. An ounce of mercury was fed for every 2½ lb. of dry concentrate and the time of contact lengthened to 3 hours.

The reason for not cutting out a head-sample from the concentrate at this point prior to amalgamation, thus saving the time and expense incurred in amalgamation, is somewhat analogous to experience when endeavoring to secure an accurate battery-splash sample with the 40-mesh slotted screens. The concentrate contained (exclusive of the gold retained in the battery through failure to pass the battery-screen) the bulk of the free gold in the ore and was a high-grade product, considering the ratio of concentration as compared with the crude ore. This fact and also the fact that from 80 to 90% of the value of the concentrate was amenable to amalgamation indicates that a slightly greater proportion of the value was in free gold, because rusty gold in small quantity was not uncommon.

Following amalgamation in the barrel, the concentrate was discharged into a settler, the thin amalgam being recovered as in the sand method. The loss in mercury in this case varied from 8 to 29% of that originally fed, the increase in loss over the sand method being due to the larger quantities handled and the slight oxidization of the concentrate while drying, this tending to 'sicken' varying quantities of mercury.

The concentrate-reject after having been deprived of its free gold was quartered in the usual manner to a final 3 to 5 lb. pulp for assay. The assay-result when divided by the ratio of concentration and added to the value of the retort-gold treated in the same manner was considered the recovery-value per ton. The figure ob-

tained in this manner corresponded closely with the recovery-value in the sand method, differing only in the fact that it was based on the treatment of the total tonnage milled and it represented, in addition to the gold amenable to amalgamation, the major portion of the relatively small proportion of gold chemically combined in the concentrate.

Tailing from the Wilfley table was sampled by an automatic machine actuated by water flowing alternately into either compartment of a V-shaped box divided at the centre, at which point the box was supported by a single bearing. The tipping action of the box at alternate ends resulted in swinging a rigidly affixed pendulum to which the sample-cutter was attached across the discharge of the launder. Plungers attached to the bottom of the box at each end, working in water-filled cylinders with sufficient clearance to permit free movement, resulted in giving the cutter a uniform rate of speed across the launder. The rate at which this cutter worked was made to conform as closely as possible with the cutter that sampled the battery-splash, so that samples of approximately equal weight were obtained.

The sample of the Wilfley-table tailing was then dried and quartered to a final 3 to 5-lb. pulp as previously described. As in the sand method the sum of the tailing-value and recovery-value was checked against the battery-splash and the arithmetical average of the two accepted as the 'indicated value' of the ore exclusive of the battery-recovery which was determined at the conclusion of the test and taken into account in the total indicated value of the ore.

The checks obtained by this method, as well as those by the sand method and a fair comparison of the accuracy of the two methods, may be seen in the following tabulation. This shows the discrepancy between the battery-splash and the sum of the recovery-value and tailing-value on the same ore when run in conjunction. Each test represents the combined results of three or four daily samples or the run of an equal number of days, and does not take into consideration the battery recovery; that being the same in either method.

Test number.	Tons milled.	Sand-method discrepancy between B.-S. and R.-V., T.-V.	Concentrate-method discrepancy between B.-S. and R.-V., T.-V.
16	35.791	$0.039	$0.063
17	42.915	0.108	0.034
18	31.511	0.044	0.021
19	32.284	0.055	0.059
20	33.083	0.019	0.008
Total	175.584		
Average discrepancy		$0.054	$0.037
Arithmetical average of discrepancies using both methods			$0.0405

The tests on the above 175.5 tons of ore represented the sampling of approximately 70 ft. of continuous width of orebody.

There is little to choose between the two methods, each having its distinct advantages. The sand method is the more rapid and less expensive, but it is open to the objection that results are based on the treatment of so small a proportion of the total tonnage milled and therefore is absolutely dependent for accuracy on the perfect working of the automatic sampler at the battery-splash. The results in the concentrate method, on the other hand are based on the treatment of the entire tonnage milled and in the long run would probably prove the more accurate.

When run in conjunction, as in this case, these methods are considered to act as balance-wheels for each other and to establish a sure and safe control of the value of the ore to within 4 or 5 cents per ton. The success of the method lies primarily in fine grinding prior to any attempt at sampling and also in careful and painstaking effort throughout each step, as well as a tendency at no time to rush the work to a point where the accuracy of the results can be impaired. This effort was also extended to the assay-office where it is sufficient to state that all the work amounted virtually to umpire assaying, 3 to 6 charges of 1½ to 2 assay-tons being run on all mill-samples.

Copper in China

According to a Consular Report there are some rich copper areas in the Yunnan province. The late Ch'ing dynasty depended on the metal from that province for the minting of copper 'cash.' The Imperial government appointed officials to supervise the mining works, and at one time the Yunnan mines regularly shipped 6,000,000 catties (1 catty = 1⅓ lb.) of copper to Pekin every year. The best mines are situated in the Tungchuan district. During the Taiping rebellion mining operations were suspended, the supply of copper to Pekin was cut off, and the Government had to resort to minting 10-cash copper pieces so as to save material. After the Taiping rebellion, not much success has been obtained in operating the properties.

On the establishment of the Republican government the copper mines were taken over by the Tungchuan Mining Co. This company had a capital of $300,000, the Government supplying one-half of the capital. But the capital has never been fully subscribed, and the company has never secured satisfactory results in development of the mines. Consequently the output is small, and as the adoption of antiquated native methods means greater expenses, the price quoted by the company for its copper is high. Thus the various Government mints found it unprofitable to purchase Yunnan copper, and therefore the raw material for the minting of copper coins was all secured from Japan and other countries.

The Government recently organized the Gold Mining Bureau, under the Ministry of Finance, to control the gold, silver, copper, and other metals necessary for the minting of coins. The department now requests that a high official be appointed to superintend the development of the copper mines at Tungchuan. The Tungchuan Mining Co. will be taken over by the Government, so that better results may be secured.

Electrolytic Precipitation of Gold, Silver, and Copper From Cyanide Solutions

By G. H. CLEVENGER

Introduction

*The present unsettled condition of the metal market, more particularly as regards zinc and aluminum, which are used now almost exclusively as precipitants in the cyanide process, makes a consideration of electrolytic precipitation, which is apparently the most feasible substitute, of particular interest at this time.

The solutions precipitated in present-day cyanide practice may contain a great variety of compounds arising from the decomposition of the cyanide, as well as from its combination with elements in the ore treated, or introduced by chemical methods of precipitation. The principal constituent of such solutions, if zinc precipitation were not used, would be simple alkaline cyanides, alkaline hydrate, gold and silver, and copper, if it occurs in a soluble form in the ore undergoing treatment. The proportion of these various constituents present, particularly of the gold and silver, is extremely small compared with the amounts of metal present in solutions made by extraction processes in other industries.

Perhaps a clearer idea of the small amount of metal involved, particularly in the case of gold, will be obtained by expressing the proportion fractionally. In solutions containing 0.50 oz. of gold per ton, an unusually high proportion, the gold would form only 1/58,332 part of the solution. In a solution containing 0.05 oz. gold per ton the gold would constitute only a 1/583,320 part. In the case of waste solutions, which should be precipitated before they are discarded, it is not unusual to deal with solutions containing less than 0.01 oz. of gold per ton (20 cents), or only 1/2,916,600 of the total weight of the solution. Tail solutions containing only 1 or 2 cents per ton are common at many mills using zinc-dust precipitation.

The electrolytic precipitation of gold and silver from cyanide solutions, therefore, involves the total precipitation of an extremely small weight of metal from solutions containing a comparatively small proportion of soluble salts, and which are therefore poor electrical conductors. The fact that the alkaline cyanides are readily decomposed by electrolysis and that the economy of the cyanide process depends upon the continued re-use of the solvent make it imperative to precipitate with the minimum decomposition of cyanide, and preferably with a regeneration of cyanide.

Siemens-Halske Process. The precipitation of gold and silver from cyanide solutions by electrolysis, employing a soluble anode of the metal to be deposited, had been practised in electroplating long before the complete precipitation of gold and silver from the dilute solutions resulting from ore treatment was attempted by electrolysis, using an insoluble anode. In 1887 Dr. Siemens, acting upon observations made at his plating plant at Berlin, Germany, taken together with the statements of chemical authorities that gold was soluble in solutions of the alkaline cyanides, developed a process of gold and silver extraction involving the use of dilute solutions, and electrolytic precipitation. In the course of this work zinc filings had been tried as a precipitant, but with the very dilute solutions employed electrolytic precipitation proved more satisfactory. The first experimental plant was erected at Siebenburgen for extracting gold from concentrate, and although the process was in successful operation as early as 1888 in other mining localities it was not until a number of years later, in 1893, that the Siemens-Halske process was introduced on the Rand goldfield of South Africa.

With the application of decantation to the unleachable portion of the slime, which had previously been allowed to accumulate, the problem at once arose of precipitating gold from large volumes of solution that were weak in both cyanide and gold. At that time the ordinary zinc-shaving method of precipitation did not give satisfactory results when used with very weak solutions. The Siemens-Halske electrolytic process, therefore, came into general use for precipitating the solutions from slime treatment.

In the Siemens-Halske process, iron anodes $\frac{1}{8}$ to $\frac{1}{4}$ inch thick, and lead-foil cathodes about 0.00032 inch thick were used. In general, the anodes and cathodes were set vertically and about $1\frac{1}{2}$ inches apart. There was considerable variation in the size and arrangement of the anodes and cathodes. At the Worcester plant they were 7 ft. long by 3 ft. wide, but in later installations, to facilitate handling, they were made smaller. The anodes were enclosed in sacks of textile material for the two-fold purpose of preventing short circuits and of collecting the prussian blue and iron oxide formed from the iron anodes.

The lead-foil cathodes were frequently cut in narrow strips for the purpose of increasing the surface. These were strung upon iron wires mounted in light wooden frames. Another expedient that gave still greater surface was to cut the lead into shavings similar to zinc shavings. These were packed into the space between the covered anodes. Various arrangements of the precipita-

*Abstract of paper presented at the twenty-eighth general meeting of the American Electrochemical Society in San Francisco, September 16-18, 1915.

tion units were tried, but the one most favored was to construct the containing box with alternate wide and narrow compartments, the narrow compartments serving for the down-flow of the solution, while the anodes and cathodes were suspended in the wide compartments, through which the solution had an upward flow.

This general arrangement will be recognized as being similar to that of the boxes used for zinc-shaving precipitation. The current density used was from 0.03 to 0.06 ampere per square foot of anode surface. The aim was to obtain a coherent plating of the gold upon the lead cathodes. After sufficient gold had accumulated upon the cathodes (2 to 12% of their weight) they were removed, melted, and the gold recovered by cupellation, either locally or at a central reduction plant.

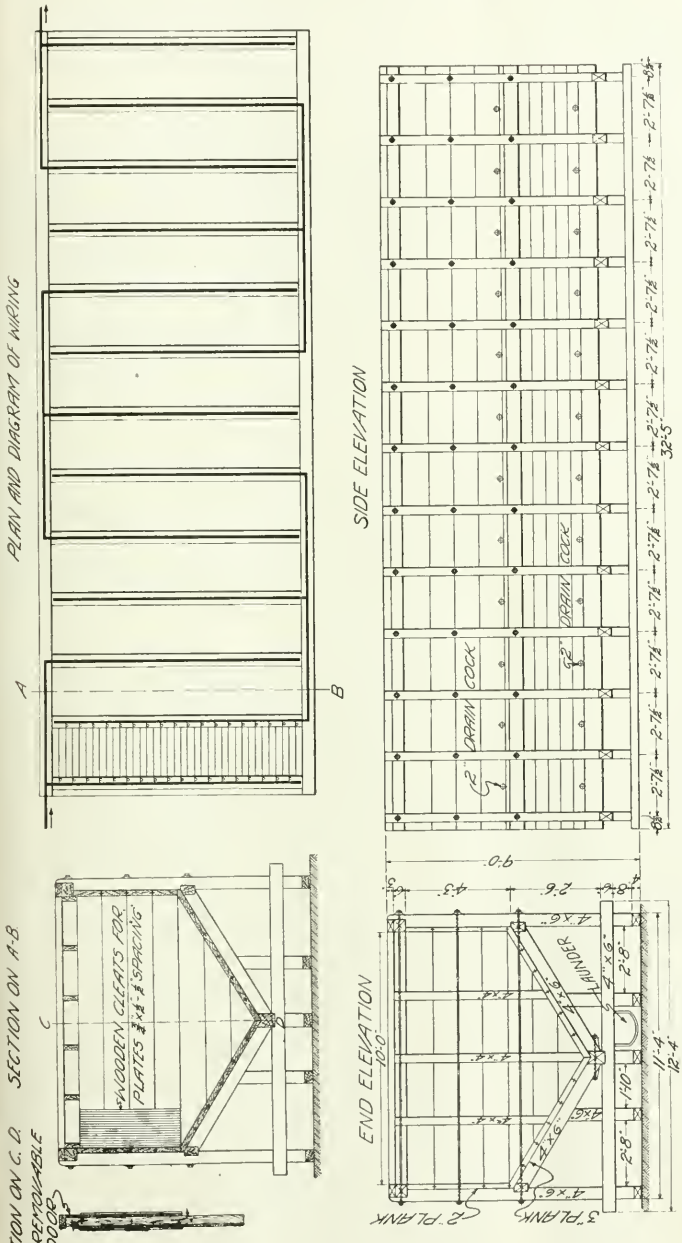


Fig. 1. Electrolytic precipitation-box, Virginia City, Nevada.

There was a long and bitter controversy on the Rand regarding the relative merits of zinc and electrolytic precipitation. In 1898, Betty, by means of a drip of strong cyanide solution at the head of the zinc-boxes, in conjunction with the zinc-lead couple, which was first proposed by MacArthur in 1894, demonstrated that precipitation by zinc could be used satisfactorily for solutions low in both cyanide and gold. After satisfactory precipitation of these dilute solutions by zinc became possible, electrolytic precipitation rapidly lost ground and finally was entirely superseded by zinc precipitation.

Minas Prietas. In 1899, Charles Butters, who had been identified with the introduction of the Siemens-Halske process in South Africa, assisted by two members of his former staff, H. T. Durant and E. M. Hamilton, developed a new electrolytic precipitation process, which was first successfully used for a number of years in connection with the cyanidation of a large deposit of pan-amalgamation tailing, and later of ore directly from the mine at Minas Prietas, Mexico.

The original plant for electrolytic precipitation consisted of six wooden boxes, 30 ft. long by 10 ft. wide and 5 ft. deep, having a slope of one inch per foot toward one side, to facilitate the removal of precipitate. The precipitation-boxes were divided by wooden partitions in-

to alternate wide and narrow compartments, 12 of each. The partitions were so arranged as regards the bottom that the narrow compartments throughout the box served only for the down-flow of the solution, while the wide compartments, in which were suspended the anodes and cathodes, served for the upward flow of solution. Each wide compartment was fitted with 18 lead anodes whose surface was coated with lead peroxide, formed by electrolysis in a special cell, and 17 cathodes composed of lead foil, cut in strips, strung upon wires supported by wooden frames similar to the cathodes used with the Siemens-Halske process. The current was supplied by two dynamos, each capable of developing 250 amperes at 30 volts, feeding into copper bus-bars $1\frac{1}{4}$ by $\frac{1}{4}$ inches laid on top of the boxes. In order to insure good contacts, the wires leading from the individual anodes and cathodes were soldered to the bus-bars, mercury-cup contacts having proved unsatisfactory. The solution passed through three sets of boxes, each set comprising two boxes set in tandem. One set of two boxes was used for precipitating the solution resulting from sand treatment and two sets of four boxes for precipitating the solution resulting from slime treatment. The current density was so regulated that the metals were deposited as a flocculent precipitate which fell to the bottom of the compartments in the form of a fine slime, as in zinc-shaving precipitation, rather than as an adherent coating upon the cathodes as in the Siemens-Halske process. After a short period of operation, it was found that the precipitate did not all fall to the bottom of the box, but that part of it formed a loosely-adherent mass on the cathodes. This necessitated washing and shaking of the cathodes when it was desired to make a complete clean-up. It was soon apparent that the fragile lead-foil cathodes could not long withstand such treatment. Investigation resulted in abandoning the lead-foil cathode in favor of a cathode made from ordinary tin-plate, which possessed the necessary strength and from which the precipitate could be readily brushed without removal of the cathodes from the containing box.

The pan-amalgamation tailing cyanided at this plant resulted from the treatment by raw pan-amalgamation of a comparatively simple silicious silver-gold ore. After the tailing deposit had been exhausted, the low-grade ore from the mine was treated. The sand was treated by percolation and the slime by agitation, natural settlement and decantation. The volume of the solution precipitated varied as did also its metal content. The proportions of cyanide and alkali were less variable, but by no means constant. Below are given average figures covering two months' operation, for solutions resulting from sand treatment when pan-amalgamation tailing was being treated. Average amount of solution precipitated per 24 hours, 216 tons. Current density 0.55 amperes per square foot of anode surface. The voltage across the anodes and cathodes varied in the different compartments, but averaged about 3. The head solution, or solution entering the precipitation boxes, contained: 0.147 oz. gold per ton; 3.51 oz. silver, and 0.0792% cyanide in terms of potassium cyanide. The tail solution or solution leaving the electrolytic precipitation boxes contained 0.013 oz. gold per ton, 0.29 oz. silver, and 0.0938% cyanide. The gain in cyanide was 0.0146%. As 1.2 tons of solution was used in treating each ton of sand, the cyanide apparently regenerated amounted to 0.35 lb. per ton of sand. The percentage of gold precipitated was 91 and the percentage of silver precipitated was 91.7. No attempt was made to lower the gold and silver in the tail solution, as none of it was used for final washes.

The following are average figures covering the same two-month period for the precipitation of solution resulting from slime treatment: Average amount of solution precipitated per 24 hours, 480 tons. Current density 0.3 ampere per square foot of anode surface. The voltage across the anodes and cathodes averaged 2.6. The head solution contained: 0.055 oz. gold per ton, 1.45 oz. silver, and 0.0409% cyanide. The tail solution contained: 0.0067 oz. gold, 0.15 oz. silver, and 0.0527% cyanide. The gain in cyanide was 0.0118%. As 4 tons of solution was used for each ton of slime, the cyanide apparently regenerated amounted to 0.94 lb. per ton of slime. The percentage of gold precipitated was 88 and the percentage of silver 89.6. When the solution flow was cut down to two-thirds normal, the tailing contained 0.0025 oz. gold and 0.06 oz. silver per ton. The regeneration of cyanide was doubtless greater with the solution resulting from the treatment of the slime on account of the greater proportion of copper contained. When treating ore directly from the mine containing little or no copper, the regeneration was not sufficient to be detected by ordinary titrations.

San Sebastian. The original electrolytic precipitation plant installed at Butters' Salvador Mines, at San Sebastian, Salvador, was similar to the Minas Prietas plant. However, it was found necessary to modify the practice in several particulars. The two wooden containing boxes were 30 ft. long, 10 ft. wide, and 4 ft. 8 in. deep. The bottom was given a slope to one side at the rate of one inch per foot. Each box was divided into 12 compartments, 10 of which were used for precipitation, the last two merely serving as settlers. Each compartment contained 25 anodes and 24 cathodes. The anodes were rolled lead plates $\frac{1}{2}$ inch thick, 22 in. wide, and 48 in. long. For some time the anodes were peroxidized in a special cell using an electrolyte consisting of 1% of potassium permanganate and 2% sulphuric acid; but later untreated lead plates were used. At first tin-plate cathodes similar to those used at Minas Prietas were tried, but difficulties arose that made it necessary to abandon the tin-plate cathode. The original intention was to deposit gold and copper as a non-adherent slime, as at Minas Prietas, but despite the fact that a higher current density was used the gold and copper were deposited upon the cathodes as a firmly adhering coating. The predominating metal in the solution at Minas Prietas was silver, but at San Sebastian it was copper. The well-known fact that silver is prone to give non-adherent coatings, while copper has a strong tendency to give ad-

herent coatings, seems to offer a ready explanation of the difference in behavior of the precipitated metals at the two plants. The removal of the strongly-adherent copper-gold plating from the tin cathodes presented a most difficult problem. Various expedients for removing it were tried, such as heating the cathodes with a gasoline

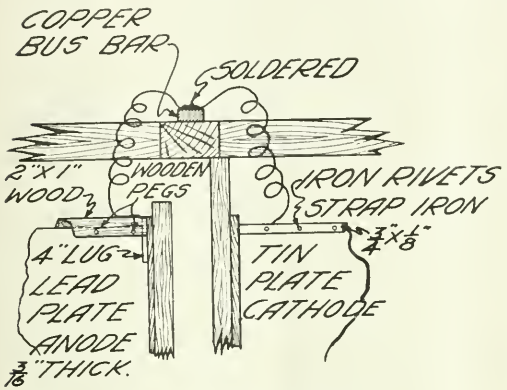


FIG. 2. ELECTRICAL CONNECTIONS.

torch, scraping and pounding them, etc. After these various heroic measures had proved ineffective, it was decided to return to the lead-foil cathode cut into strips, as used in the Siemens-Halske process. When it was desired to clean-up, the lead-foil strips were removed, ground, and shipped to smelters for the separation of the metals. The current was supplied by a belt-driven dynamo giving 450 amperes at 30 to 35 volts. The current density was 10 amperes per square foot of anode surface, and the voltage across the anodes and cathodes in each compartment was 4 to 4½.

This general practice was continued until C. P. Richmond modified it so that the metals could be separated locally.* The lead-foil cathodes were replaced by sheet-lead cathodes $\frac{1}{16}$ in. thick, 22 in. wide, and 48 in. long, so arranged that they could be readily removed from the containing-box. To this end, the connecting wires for the cathodes, instead of being soldered to the copper bus-bars, were clamped by wing-nuts in split studs screwed into the bus-bars.

The wires from five anodes and cathodes of opposite compartments were laid in each slot and a tight connection secured by screwing down the wing-nut. The studs were spaced 19 inches apart and six of them connected the cathodes of one compartment to the anodes of the adjoining compartment. By this arrangement it was possible to remove any of the cathodes without interrupting the flow of current or solution. At San Sebastian it was found advantageous to operate so as to keep the concentration of the copper down to a point where it did not interfere with gold extraction, and precipitate the remaining gold by zinc shaving. This was done despite the fact that zinc was said to interfere with electrolytic precipitation in South Africa. The solution leaving the electrolytic-boxes was divided between two zinc-boxes each 22 ft. long and having compartments, 2 ft. by 1 ft. and 2 ft. deep, filled with zinc-shaving. The material was a high-grade gold ore containing considerable pyrite and sufficient copper left in the soluble form after the roast preceding cyanide treatment, to occasion trouble in cyanidation unless electrolytic precipitation were used. The average gold-content varied, but at the time that electrolytic precipitation was in use it ranged from 2 to 4 oz. per ton. The soluble copper varied from ½ to 2½ lb. per ton. The ratio of gold to

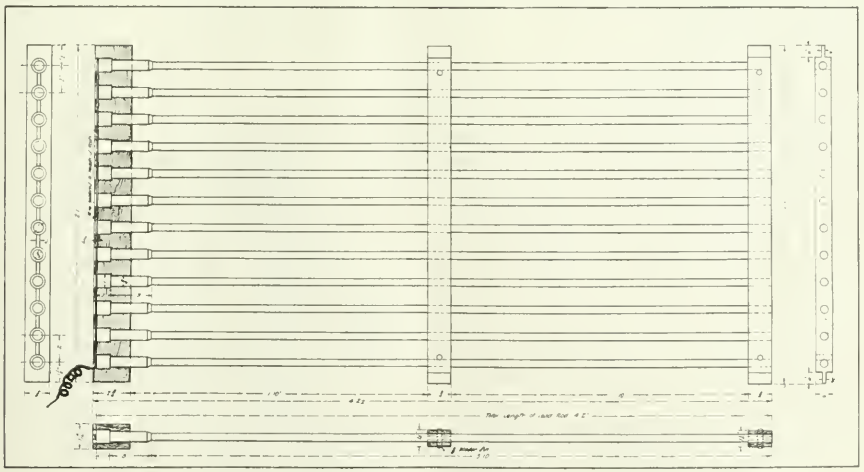


FIG. 3. LEAD-ROD ANODE.

*For details of the electrolytic separation of the copper-gold deposit, see 'The Electrolytic Precipitation of Gold, Silver, and Copper from Cyanide Solutions.' By G. H. Clevenger. Vol. XXVIII, Trans. Amer. Electro-Chem. Soc.

copper in the electrolytic deposit ranged from 1:7 up to as high as 1:25, but generally was between the limits of 1:9 and 1:14. The average results of two months, taken at random, will give a general idea of the performance. During this period there was treated 45 tons of ore daily, averaging 2.27 oz. gold per ton. Approximately 150 tons of solution was precipitated daily. The average content of the head solution was: gold 0.79 oz. per ton; copper, 0.075%; cyanide, 0.118%. The average content of the tail solution from the foot of the zinc-box was gold 0.004 oz. per ton, copper 0.048%, cyanide 0.154%. The percentage of gold in the deposit at the head of the electrolytic-box was about 7; at the foot of the box it was about 3. The current-density was 1 ampere per square foot of cathode surface. The voltage across the anodes and cathodes of each compartment was 4 to 4½. During the treatment of the ore there was consumed 7.2 lb. of sodium cyanide per ton. There was precipitated in the electrolytic-boxes 1.5 lb. of copper and apparently there was regenerated 1.92 lb. of cyanide, in terms of potassium cyanide, per ton of ore treated. Eighty to 90% of the gold and most of the copper was precipitated in the electrolytic-boxes. Passage through the zinc-boxes brought the total percentage of gold precipitated up to 99.5. The zinc-boxes precipitated little copper despite the fact that the solution invariably contained copper at this point. Under normal conditions the percentage of copper in solution remained nearly constant, any increase through contact with the ore being precipitated by the electrolytic-boxes. When the copper accumulated in the solution, as was sometimes the case through treating ore containing an unusually high proportion of copper, the bad effect was at once noted upon the gold extraction.

Virginia City. In the installation of the electrolytic precipitation plant at Virginia City, Nevada, Chas. Butters & Co., Ltd., had the benefit of the experience gained at the plants previously installed by them. This resulted in several important improvements. Originally there were nine boxes, similar to that shown in Fig. 1, the idea being to use three of these boxes for precipitating copper from a preliminary wash by sulphurous acid, which, when the plant first began operations, was intended to precede cyanide treatment. The other six boxes were to be used for precipitating gold and silver, together with any copper remaining from the cyanide solutions. The preliminary treatment with sulphurous acid was finally abandoned and direct cyanidation practised. The precipitation practice finally evolved for the cyanide solution was to use four of the boxes in pairs of two arranged tandem, the solution issuing from the first set of boxes passing through the second set. As at San Sebastian, electrolytic precipitation was followed by zinc-shaving. The zinc-box was improvised by placing screens in the bottoms of a number of the compartments of two of the discarded electrolytic-boxes.

At Minas Prietas the method of handling the precipitate was rather crude, as a part of the cathodes and anodes had to be removed to give access to the bottom of the boxes during the clean-up. At Virginia City this feature of the process was greatly improved by constructing the precipitating boxes with hopper bottoms. In each compartment where one of the sloping sides of the hopper joined the vertical side of the box was placed a valve through which the bulk of the solution contained in the box could be drawn prior to sluicing out the precipitate. At the apex of the hopper in each compartment was placed another valve through which the slime could be sluiced to a launder that conveyed it to a small concrete tank equipped with a mechanical agitator, whence it was pumped by a centrifugal pump into an ordinary distance-frame and plate type of filter press. After drying, the precipitate was sampled and shipped to the Selby Smelting Co. Later, a refinery was built. The precipitate, after retorting to recover mercury, and after the addition of the proper admixture of fluxes, was melted in graphite crucibles heated in specially designed tilting furnaces. With the arrangement described above it was not necessary to disturb the anodes or cathodes when cleaning up. Each box had 12 large compartments, in which were suspended 18 peroxidized sheet-lead anodes ¼ inch thick, 25 in. wide, and 48 in. long, and 18 tin-plate cathodes of the same size. Sheet aluminum cathodes were also tried. Later, an anode composed of lead rods was used. The advantage of this anode was that it could be made locally from scrap lead or old anodes. The Wood dynamos, each giving 500 amperes at 50 volts, and direct connected to an induction motor, furnished the current.

The character of the ore treated at this plant varied greatly. Originally it was built to treat a large accumulation of tailing resulting from the treatment of Comstock ores by pan-amalgamation. Later Comstock ore and concentrator tailing, and ore from the Tonopah district, were treated. The treatment of outside ore began before the exhaustion of the tailing, so that at times there was a varying mixture of tailing and ore. The pan-amalgamation tailing had been re-treated a number of times by the same process and was, therefore, very low grade. It contained copper, mercury, and chlorides as a result of the chemicals added during pan-amalgamation. The tonnage and metal content of the solution varied considerably, but the following is an average of the results obtained over a period when treating pan-amalgamation tailing exclusively, and precipitating 474 to 668 tons of solution daily. There was no distinction made between the solution originating from the sand and slime treatment, the two being combined for precipitation. The average content of the head solution per ton was: gold 0.033 oz., silver 0.78 oz., no record of copper determinations, cyanide 0.046%, protective alkali 6 points. The tail solution from the electrolytic-box contained: gold 0.01 oz., silver 0.22 oz., cyanide 0.066%, protective alkali 4 points. The zinc-box tails contained: gold 0.003 oz., silver 0.03 oz. The current density was 0.245 amp. per sq. ft. of anode surface. The voltage across the anodes and cathodes in each compartment was 3.1. The average content of the head solution when treating a mixture of Tonopah ore and pan-amalgamation tailing was: gold 0.055 oz., silver 3.15 oz., cyanide

0.18%, protective alkali 10 points. The tail solution from the electrolytic boxes, when precipitating 432 tons per 24 hours, contained: gold 0.02 oz., silver 0.60 oz., cyanide 0.18%, protective alkali 10 points. The current density was 0.245 amp. per sq. ft. of anode surface. The voltage across the anodes and cathodes in each compartment was between 3.1 and 3.2.

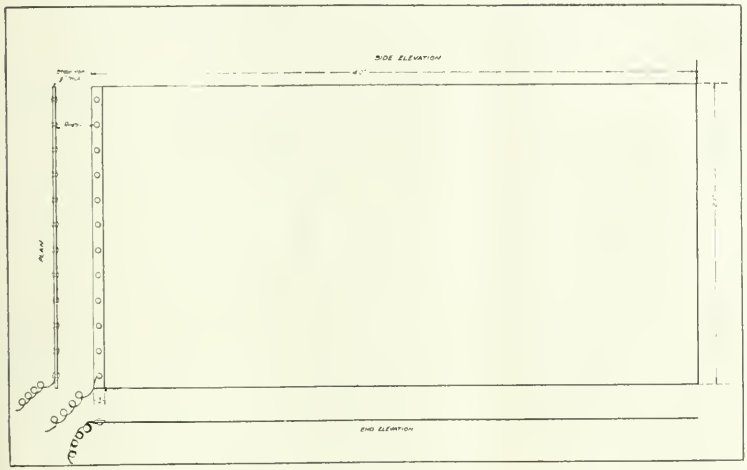


FIG. 4. TIN-PLATE CATHODE.

EL RAYO. The equipment installed at El Rayo, Mexico, followed rather closely the lines of that used at San Sebastian, and consisted of one wooden box 10 ft. wide by 20 ft. long, 4 ft. deep on one side and 5 ft. deep on the other, with the usual arrangement of wide and narrow compartments. In each of the seven compartments were fitted 25 sheet-lead anodes, 20 in. by 40 in. and $\frac{1}{4}$ in. thick. Alternating with the sheet-lead anodes, there were 24 sheet-copper cathodes, 20 by 40 in. and 1/32 in. thick. Electrical connection of the anodes and cathodes to the bus-bars was made by means of lead plugs cast onto the plates, to which were soldered copper connecting wires. The current was supplied by a generator giving 500 amperes at 50 volts.

At the time that this installation was made, zinc-dust precipitation of the gold and silver was giving satisfactory results. A change in the character of the ore indicated that trouble might arise through a greatly increased proportion of copper. It was, therefore, planned to continue to precipitate with zinc and depend upon electrolytic precipitation to keep the copper in solution down to a concentration that would not interfere with cyanide treatment.

ANODES. Iron anodes were used with the Siemens-Halske process in South Africa, but lead, with a few exceptions, has been used in American practice. Various other anode materials have been tried, but, everything considered, lead is the most satisfactory. One important advantage that lead has over many other anode materials is that it has a certain salvage value after it has served its useful life as an anode. It has been used both plain and peroxidized, but in general the peroxidized anodes have had the longest life. Many investigators have reported certain anodes as being satisfactory when used in cyanide solutions, but these tests carried on in a small way have always covered entirely too short a period of time. The fact that an anode will stand up for two or three days of continuous operation in no way signifies that it will be satisfactory for a period of operation sufficiently long to make its use commercially economical. Experiments with Acheson graphite have been most disappointing, notwithstanding the favorable reports made by other investigators who have tried this

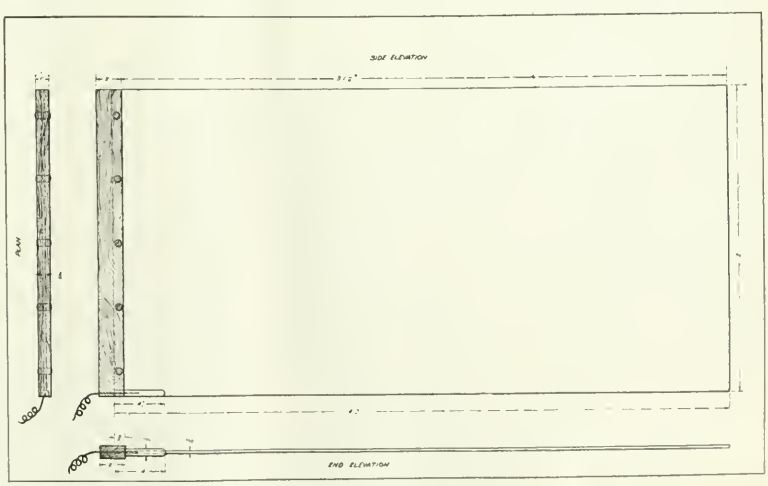


FIG. 5. SHEET-LEAD ANODE.

material in a small way for short periods of time. The graphite anodes gradually become mushy and soft and finally are useless. The reason for the failure of the graphite anode is not clear, but at one time I thought that it was due to disintegration of the binding material used in the original carbon plates from which the graphite plates were made. In other words, the graphite resulting from the carbonaceous binding material of the original carbon plate does not appear to form a strong union with that resulting from the carbon proper of the plate.

The sheets of lead, after cutting to the desired size, are thoroughly cleaned and in one corner or on the two opposite corners of the short dimension of the sheet is cast a special connecting lug, $\frac{1}{2}$ inch diam. by 4 in. long, by means of a special iron mold that clasps the plate firmly at the point where the lug is to be attached. The lugs are cast from lead to which has been added a small amount of tin, to lower its melting point. The temperature of the lead used in casting the lug should be such that it does not melt through the lead sheet, but still is sufficiently hot to form a thorough union with the lead sheet. A tongued wooden supporting strip is attached to the top of the plate by means of wooden pins. The whole arrangement is shown in Fig. 5.

Fig. 3 shows the detail of the lead-rod anode.

The lead-rods are cast in special iron molds, observing the usual precautions for preventing the oxidation of lead during melting and the obtaining of a clean, smooth casting free from holes or spongy spots. Twelve of these rods supported in strips of pine drilled to receive them at the bottom, at the centre, and at the top, comprise an anode. The bottom and centre strips are 1.75 by 1.25 in., and are kept from shifting by means of wooden pins that engage the two outside rods. These also serve to prevent short-circuiting of the tin-plate cathodes, which have a strong tendency to buckle. The top strip, $2\frac{3}{4}$ by $1\frac{3}{8}$ in., is counterbored to receive the large ends of the rods, and supports the whole weight of the anode. Electrical connection to the individual rods is made by soldering to them a No. 10 copper wire, which rests in a groove at the top of the strip. The continuation of this wire serves as the means of connecting the anode to the bus-bar.

The method of peroxidizing the anodes varied at the different plants. This operation was performed in a separate cell where a few anodes at a time were treated. The first step was to clean and brighten thoroughly the surface of the lead with a scratch-brush. At Minas Prietas a 1% potassium permanganate solution was used and a current density of 1 amp. per sq. ft. The time was one hour or longer. During the operation the strength of the solution was frequently tested with a standard solution of ferrous sulphate, fresh permanganate being added to keep the solution as near 1% as possible. At San Sebastian various combinations were tried, but the practice that met with the most favor was to use an electrolyte containing 1% of potassium permanganate, 2% sulphuric acid, and a current density of $2\frac{1}{2}$ amp. per sq. ft. The time of treatment was 6 hours. In passing, it is well to mention that it has been found in certain of the electrochemical industries that a denser and more satisfactory coating of the peroxide is formed if the operation is performed in an alkaline solution.

At Virginia City the peroxidized lead anodes had a life of about one year. At San Sebastian, on account of the higher current density, the life was 8 to 12 months. At Minas Prietas the life was in some cases considerably over a year.

Cathodes. The lead-plate cathodes used at San Sebastian were constructed similar to the anodes, except that the sheet lead used was thinner.

An interesting feature of the lead cathodes used at the Reliance mill was that they were not ordinary rolled sheet lead, as had been previously used elsewhere for both anodes and cathodes, but were plates cast upon an inclined machine at the Trail smelter. It was said that one man could make 500 cathodes in a shift.

The tin-plate cathode was made from medium-weight tin-plate, as shown in detail in Fig. 4. A piece of strap iron $\frac{3}{4}$ by $\frac{1}{8}$ inch, the length being the same as the width of the plate, was riveted to the top. The connecting-wire was introduced between the plate and strap-iron in such a manner that one of the rivets clamped it firmly in place. Fig. 6 shows the tool used in removing the portion of the deposited metals which adhered to the cathodes. The double brush was used at intervals for removing the slightly adherent deposit. The manner of using was to set it over the cathode so that a brush was bearing on either side of the cathode, when the whole tool was pressed downward until the brushes had reached the bottom of the plate; this operation was repeated until the whole surface of the plate had been covered. When it was desired to make a complete clean-up, especially if the plates were old, it was necessary to remove them entirely from the box and scrape them with the triangular scraper, shown in Fig. 6.

The By-Products have always presented a serious problem. In the Siemens-Halske process, the Prussian blue, formed as a result of the attack on the iron anodes, had to be subjected to special treatment for the recovery of the cyanide and gold. The disadvantages arising through the separation of calcium salts, which deposited upon the anodes and cathodes and in the bottom of the box, was early noted in the application of the process. It has been variously estimated that from 0.6 to 25% of the gold had to be recovered from the by-products in the Siemens-Halske process.

At Minas Prietas, the precipitation of calcium salts was especially troublesome, and owing to the method of operating in which the non-coherent deposit of the metals was collected in the bottoms of the boxes, all of this eventually became intermingled with the precipitate. At this time the calcium salts, chiefly the carbonate, formed a large proportion of the precipitate. This made the precipitate more difficult and costly to smelt.

Lower current-density lessens the formation of the lime precipitate, but does not entirely eliminate the difficulty. In the course of time the lead anodes disintegrated so that they had to be discarded. At first

these were shipped to lead smelters, but later they were re-melted locally, and after the separation of the dross, which had to be shipped to the smelter, were cast into slabs that were rolled by a special set of rolls into sheets which were used in making new anodes.

At San Sebastian, where the gold and copper formed a coherent deposit upon the cathodes, it was possible to keep the deposit that accumulated at the bottom of the box separate from the deposited metals. However, the gold contained in this material was considerable, and at one time, when a considerable amount of it had been allowed to accumulate, it represented a great deal of money. The material more directly resulting from the disintegration of the anodes contained:

	%		
Lead	53.7	to	57.1
Copper	3.1	to	4.7
Gold	0.031	to	0.154

The fine material, or 'lime' as it was termed, contained:

	%		
Silica	8	to	10
Alumina	22	to	28
Calcium oxide	15	to	21
Lead	Not Determined		
Copper	5.9	to	6.9
Gold	0.322	to	0.363

A small blast-furnace and other equipment for refining was installed for treating the by-products, but on account of the high cost of coke and other supplies and the lack of skilled labor, it was generally found more economical to ship this material to smelters in the United States. No attempt was made to reclaim the anodes.

At Virginia City the conditions were much the same as at Minas Prietas. A lower-grade precipitate was invariably obtained from the electrolytic-boxes than from the zinc-boxes on account of the calcium precipitate. At one time, as the result of careful sampling and assaying, it was estimated that the anodes contained about 10,000 oz. silver. This came about by reason of the fact that the solutions contained chlorine. The source of this in the tailing was the salt added during pan-amalgamation and, in the Tonopah ore, was due to the occurrence of part of the silver as chloride. The presence of the silver as chloride in the anodes was proved by solution in ammonia and the regular qualitative tests. In the earlier operation the disintegrated anodes were shipped to the smelter; but later it was found that by careful heating in suitable pots the greater part of the metallic lead could be liquated, leaving most of the gold and silver in the dross, which was shipped to the smelter and the lead cast into rods that were mounted in wooden supports and used as anodes.

Cost of Installation and Operation. The cost of the six electrolytic precipitation boxes at Minas Prietas, Mex., was as follows:

Box construction	$10,000
Dynamos	3,000
Lead anodes	4,455
Tin-plate cathodes	300
Wiring, switchboards and instruments	1,000
Labor	1,000
Incidentals	250
Total for six boxes	$20,005

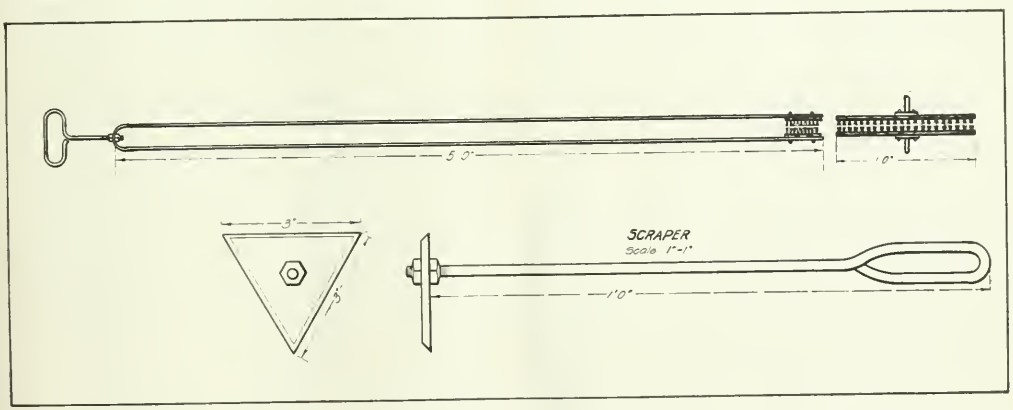


Fig. 6. Tools for cleaning cathodes.

At Virginia City, Nev., U. S. A., the cost of six standard boxes was as follows:

Box construction	$6,000
Dynamos	4,075
Lead anodes	4,080
Aluminum cathodes	*1,598
Wiring, switchboards and instruments	1,000
Labor	1,500
Incidentals	250
Total for six boxes	$18,503

*Tin-plate cathodes also used.

The only costs available for electrolytic precipitation are those given below, which are the average for six years' operation of the Minas Prietas plant.

Power	$0.083
Labor	0.037
Supplies	0.031
Depreciation	0.040
Total per ton of ore	$0.191

Mining in Colorado

By GEORGE J. BANCROFT

The phenomenal rise in tungsten prices from $4 to $40 per unit has produced a new variety of mining magnate. Denver is used to 'silver kings' and 'copper kings,' while gold potentates are always drifting in, but now the bell-hops at the big hotels are learning to say with bated breath: "There goes Smith, the tungsten king." The Boulder county mines are proving reliable producers of tungsten. Leadville and the San Juan have produced a little tungsten, but the orebodies are few and far between. Furthermore the tungsten is apt to occur in small streaks in veins that are chiefly valuable for other metals, so that, as a rule, it is not worth while to equip the mills to separate out a small amount of tungsten. A small production is made by hand-sorting in some mines. In the Boulder county mines the tungsten is disseminated through the vein and occurs in relatively large ore-shoots, considering that the veins are narrow for the most part, running from knife-blade seams up to three feet wide. Of course, there are some pockets that are much wider, say 10 ft., but the average width is 12 inches. The ore-shoots are relatively long and deep as compared with most tungsten mines. Several stopes are 300 ft. measured along the vein, and an average ore-shoot would be perhaps 75 ft. wide and 1 ft. thick. With tungsten at $40 per unit one can readily see that very small veins can be worked at a profit.

It appears that the War has made a tremendous demand for tool-steel for turning out shells and gun-barrels. Tungsten-steel is the most efficient material for lathe-tools yet discovered, being said to be seven times more efficient than a good grade of carbon-steel. It has been reported that the German cannon are made of tungsten-steel, which was the reason they were superior to the guns of the Allies. It is thought that relatively little Boulder county tungsten goes to gun-manufacturers. It nearly all goes to steel-makers that make a specialty of tool-steel. The Boulder county ore is unusual in being the pure tungstate of iron, ferberite. Generally tungsten occurs associated with manganese; wolframite, the tungstate of iron and manganese, and hübnerite, the tungstate of manganese, are the common ores. These minerals generally are found in concentrated isolated masses. In Boulder county the ferberite is disseminated through the vein-matter and most of it requires concentration before shipping.

In Cripple Creek there have been important discoveries in the Last Dollar, Cresson, Jerry Johnson, Portland, and other mines, but the chief attention is being given to the developments at great depth. So far, the two deepest shafts, namely, the Vindicator and the Portland, indicate that the ore persists to the greatest depth attained, namely, about 1800 ft. The Vindicator will soon be driving on the 1900 and 2000-ft. levels and the results will be awaited with interest. The 1800-ft. level has proved profitable in both the Portland and the Vindicator. As mentioned in previous discussions, the large and phenomenally rich concentrations of ore at Cripple Creek appear to be isolated occurrences. A level that happens to uncover one of these erratic orebodies becomes at once a very important working, but the fact that the deepest levels are up to the average is all that can be expected. It is said that a phenomenal orebody has been found going below the 1800-ft. level, north, in the Vindicator and there are also persistent rumors of a remarkable strike on the Portland at 1800 ft. These stories have not been confirmed officially as yet. Official reports tell us, however, that the ore thus far developed on the Vindicator 1800 is nearly twice as long as that developed on the 1600-ft. level, though of lower grade; and the Portland 1800 shows that there was no diminution in the value of the orebodies. So the outlook at Cripple Creek has well founded anticipation of a long and productive life.

The dredges have had a prosperous season. The new dredge on the Derry Ranch placer has been running only a month, but it is said to have produced $19,000 during October. Indications at present are that the total value of metals produced in Colorado during 1915 will be considerably in excess of that produced in 1914. The question of tonnage is not so well settled, but is likely to show an increase. The largest single factor in stimulating increased returns has been the high price of zinc. J. F. Welborn, the president of the Colorado Fuel & Iron Co., takes an optimistic view of the iron situation in Colorado, but deplores the over-development of the coal mines. He says in part: "The railroads are buying more freely than at any time within two years, and the demand is improving in other lines manufactured by our plant at Pueblo; we have received a number of orders for shipments abroad, including heavy exports to China. Agricultural development throughout the country is giving an impetus to orders for wire fencing, nails, and a number of other articles used in this industry."

COLOMBIA has an area of 438,000 square miles, which is larger than all the Atlantic Coast states from Maine to Florida, and has a population of 5,500,000, while Bogota, the capital, has 125,000. It has a coast 1600 miles long on the Caribbean Sea and 1500 miles along the Pacific, a total coast-line of 3100 miles. Only about 700 miles of railway is reported in operation, principally along the Caribbean Sea but extending also into the mountains. Transportation centres around the river Magdalena, which flows northward into the Caribbean; it is navigable by large vessels for 600 miles and for smaller craft 300 miles farther. Up this river foreign merchandise enters the country, the greater part of the national products coming from within a short distance of the river. Harbors on Colombia's Caribbean coast are only 1400 miles from New Orleans and but 1900 miles from New York. The country is known to be rich in deposits of gold, silver, platinum, oil, iron ore, copper, coal, and emeralds. There has been no revolution for 13 years, and the present political situation is excellent. In 1913, Colombia took 26% of her imports from and sent 55% of her exports to the United States.

Mining in Arizona

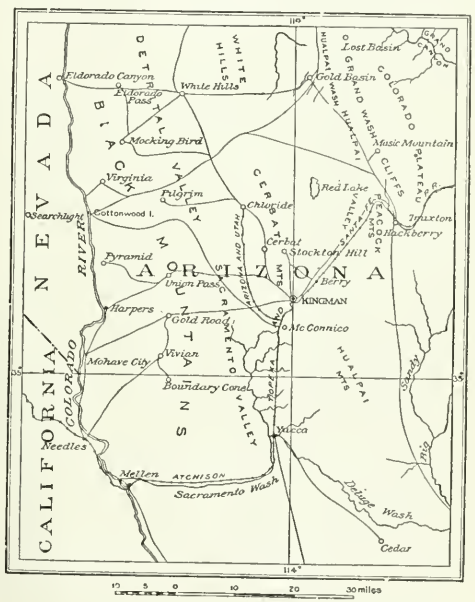
By CHARLES F. WILLIS

The leading feature of mining in this State during the past month has been the strike in the Clifton-Morenci district. The opposition to the strikers is evidently being maintained by the managements in a determined spirit, as the question involved does not alone influence the district in which the strike is taking place, but the entire region. Conditions at the various mining centres in Arizona are extremely dissimilar. At Bisbee high wages are paid and the labor is largely American; at Ray the scale of wages for Mexican labor is also high, thereby attracting the more intelligent class of Mexicans. However, at Clifton only the cheaper class of alien labor has been used, owing to the narrow margin of profit derived from these particular mines.

The abnormal condition of the copper market, its present prosperity, coupled with the low wage-scale of the Clifton-Morenci district allowed the organizers of the Western Federation of Miners an opportunity to start trouble. Heretofore the unions had been of but little influence in the mining districts of Arizona; there are unions in practically every district, but the number of organized men has been small as compared with those unorganized. Thus the immediate problem is not the adjustment of grievances on the part of the employees, but merely a recognition of the Western Federation. Natural circumstances seem to favor the mine-operators because the condition of labor at this place is such that the strikers cannot stand for any great length of time the non-payment of wages; while they get some support from the rest of the unions within the State, it is comparatively small because of the inconsiderable number of union men in the other districts.

This strike is but the climax of a struggle for political dominance that has been going on for some time between capital and labor. Arizona has had a reputation for freak laws regulating operations involving capital, and while the laws are no more freakish than in many other states, the publicity that has been given them is such as to cause outside capital to fear to enter the State, not so much for what has happened as for what may happen. Ample evidence has been offered that organized labor in the State can pass any laws that it so desires, and one side of the present struggle represents an effort to weaken labor and to prevent it from getting a firmer hold upon industrial conditions. There is little doubt that this fight will be fought to a finish. The operators have already incurred their greatest loss with the shutting-down of their plants, the caving of the mines, and the 'freezing' of their smelters. They show no haste and, in fact, little desire to meet with the employees.

While internal troubles are bad, border conditions are worse. The recognition of Carranza by the United States government has led to considerable turmoil in the territory held by Villa supporters, followed by the confiscation and damage of American property. As the greater part of Sonora bordering on Arizona is held by Villa, who is now in a bad way, American lives and property are not safe. The occupation of a border town by either one army or the other assures them revenue from export and import taxes, whereas the possession of an inland town assures no income. Moreover, the border towns pay in American money. It is evident that the



MOHAVE COUNTY, ARIZONA.

Mexicans in Sonora are not fighting for any principles or for any particular leader; it is either a case of being in an 'army' or going hungry, so they are willing to join any army that can ensure them, either by its financial condition or by its points of vantage, that they will receive their *frijoles* and *tortillas*. As the method of transportation from one place to another is either on foot or through United States territory, Carranza hopes to get control of the border by being allowed transportation on the railroads through the United States. If such privilege accompanies recognition, and an embargo is placed against those opposing him, conditions will improve.

Naco, on the railroad leading to Cananea, has been a particularly rich prize, and the army in control has

levied duty upon duty on both imports and exports. For this reason Cananea has rather been left alone and allowed to work with little destruction of property other than the burning of bridges and railroads, but the recognition of Carranza has caused the shutting-down of the Cananea property, which will probably be followed by confiscation on the part of the Villa troops.

In spite of both international and internal troubles, mining in this State is progressing. Excitement has been caused by the finding of indications of oil in the Tonto Basin. For some years oil has been suspected in the Tonto Basin country, and drilling has been going on in a rather desultory manner, many companies starting with insufficient capital and quitting before really finding out whether oil existed there in a commercial way. At a depth of 1200 ft. red shale has been cut and after penetrating 300 ft. more, the water showed distinct signs of gas with an oil scum on the surface. While it is not known yet whether anything of importance will be developed, this has not hindered local excitement.

The recent trip through Arizona of a buyer of tungsten ores has lead to an intensive stimulation of tungsten production, with the consequent immediate planning of mills and the buying and selling of tungsten properties. Globe has attracted attention by its properties in Powers gulch; in Mohave county, attention has temporarily turned from a gold boom to the operation of the Williams tungsten mine and mill near Kingman. In the Whetstone mountains a new company, the American Tungsten Co., is working several properties, while the Primos Chemical Co., a large purchaser of tungsten ore, is also operating nearby. The Tip Top mine, in Yavapai county, which for many years was worked as a silver mine, the tungsten ore being discarded, is now planning to work the dump, and will be considered as a tungsten mine with silver as a by-product. The prices reported for tungsten ores are seemingly fabulous; one report says that it sells for $28 per unit, although on the same day a report was received from another part of the State that the same company offered $35 per unit. Whichever price is correct, it is evident that the market for tungsten ores is lively.

The same buyers desire also molybdenum and vanadium, quoting $3500 per ton for 90% molybdenite ore. Molybdenite in Arizona is almost always associated with copper, and separation is difficult. Such a high price, however, offers incentive to investigation.

The Jerome district is particularly active. The Arkansas & Arizona Co., idle for nearly a year, has commenced re-timbering the shaft and installing machinery for unwatering. The United Verde Extension is now making regular shipments to Douglas, and the opinion of the early investors has been fully justified. The mine of the Hull Copper Co., although of undoubted value, has been shut-down owing to a suit against the company by G. W. Hull, the president of the company. The result has been an extremely low quotation for the Hull mining stocks. The Jerome Verde has awakened interest, doubtless because of the constant success of the United Verde Extension, the two properties being adjacent. The United Verde Extension for some time has been negotiating to gain control of the Jerome Verde since the release of the option, which expired in the month of June. This property was being developed through the lower workings of the United Verde Extension.

A mild boom has been in progress at Oatman following the sensational discoveries in the Tom Reed and United Eastern mines. Many claims have changed hands and new companies organized within the past few months; mills are in course of erection. The fact that a vigorous boom has not matured is evidence that the public is not as easily stampeded as would have been the case a few years ago. Construction work on the United Eastern mill is being advanced rapidly, the initial plant having a daily capacity of 200 tons. Crushers are used instead of stamps, the ore going from the crushers to tube-mills, then to the cyanide annex. In the Black Eagle workings of the Tom Reed, an ore-shoot has been opened to a depth of 400 ft. and recent development work has disclosed 32 ft. of ore of $20 per ton, with 14 ft. of it close to $30 per ton. Although the Oatman district is renowned for its gold, its largest producer is the Golconda mine, a zinc property. The monthly output of this district is estimated as follows:

Golconda	$250,000	Gold Road	70,000
Tennessee	150,000	Champion	35,000
Tom Reed	100,000	Scattered	35,000
Copper Giant	100,000		
			$740,000

Later the United Eastern, the Golconda Extension, and many others will be added to the list.

The Inspiration Consolidated at Miami is to erect the largest Dorr thickening-tank, with a diameter of 200 ft. The largest hitherto has been at the plant of the Arizona Copper Co., at Clifton, a reinforced concrete tank 135 ft. in diameter. Nine sections of the Inspiration mill are now in operation and about 7000 tons is handled daily.

Although few reports are issued from the Bunker Hill mine in the Tombstone district, it is evident that things are progressing satisfactorily and rapidly. In early days Tombstone was considered a great mining centre, and it has been necessary in the past few months to put up more dwellings to house those living in the district. Dr. Emil Grebe, a hard-working and conscientious mining man, has charge of the Bunker Hill.

The Las Guigas placers, about 60 miles southwest of Tucson, are again active. It is reported that this ground averages $1 per cubic yard, but it remained undeveloped because of the high cost of water. The Clark agitating-sluice is being tried, which is somewhat similar in operation to the Dorr classifier. Although not a dry machine, it works with a small volume of water. For fifty years these placers were worked in a desultory manner by Mexicans and Indians, using batea in the dry season and pan-rockers in the wet season. Bedrock is from three to ten feet; by the removal of the gravel and the panning of the ground beneath, many thousands of dollars have been extracted.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

To ENSURE that all connections in electric blasting are good, a galvanometer or circuit-tester should always be used.

THE NEW IRON COINS for replacing the German copper currency, which is being called in, are made of open-hearth steel with milled edge.

SQUARE-SET system of stoping at the Interstate-Callahan zinc mine, Idaho, has been changed to the waste-fill method. This resulted in a reduction of underground charges, and increased the metal-content of the mill feed from 20 or 22% to 27 or 30% zinc.

COBALT is highly suitable for electro-plating instead of nickel, according to researches on cobalt and its alloys at the Queen's University, Kingston, Ontario. Commercial applications have given excellent results, notably on automobiles.

QUICKSILVER METALLURGY has made few advances in latter years. Innovations are to be tried at New Almaden, California, consisting of a six-hearth Herreshoff roasting-furnace and hollow-glazed tile condensers. The latter is considered superior to the solid 9 or 12-in. brick arrangement, which absorbs considerable metal. Dumps of low-grade material are to be crushed in a ball-mill and concentrated on tables. Flotation may be tried on the slime.

IN BURKE QUARTZITE, a 6 by 8-ft. adit at the Gertie mine, Coeur d'Alene, Idaho, was driven an average of 311 ft. per month for a year. A maximum of 17 picked men was employed two shifts per day, and there were six holidays. A bonus of from $25 to $40 per man per month was paid for extra footage. The air-pipe for machines was 4 in. diameter; that for ventilation 15 in. The compressor was a good one. The blacksmith-shop was equipped for efficient work. Waste-cars were of 35-cu. ft. capacity, one horse hauling four. The cost of the work was $67,000, or, say, $18 per foot.

EXPLORATION of the New Cornelia property of the Calumet & Arizona Copper Co. at Ajo consisted of the following: Seventy acres of land was laid off in regular 200-ft. squares, and 84 diamond-drill holes were put down on the corners of these squares. These bores yielded cores and cuttings; the latter showed the geological and petrographical nature of the rock, and the former were assayed. Samples were taken every five feet, and a total of 9300 were taken. Besides the drilling of 23,097 ft., about 4000 ft. of test-pit work was done, which also was sampled every five feet, making 800 samples more. The pits were put down on the same co-ordinate points as the drill-holes, in order to check the accuracy of the drill-samples. Nothing was left to chance; 11,105 samples were taken altogether to prove the value of the orebody. In the 70 acres drilled, an orebody covering 61 acres was found, varying from 1500 to 2000 ft. long, 650 to 1500 ft. wide, and 120 ft. and over in depth.

UNDERGROUND LOCOMOTIVE HEAD-LIGHTS can be fitted with low-voltage concentrated-filament tungsten lamps in parabolic reflectors, with a decrease in trouble, increased light, and decreased breakage over the present carbon or regular tungsten filament. Two 30-volt, 100-watt tungsten-filament locomotive-headlight lamps can be burned in series with a resistance. The loss in current through the resistance is a small factor as compared with the gain in steadiness and brilliancy of illumination from the parabolic head-lights. The construction of this lamp is such that maximum strength of filament is obtained, an essential feature for such severe service.

ORE-VERTICALS are sometimes mentioned in the mining notes of our correspondent at Deadwood, South Dakota. In the stopes of some mines from which the ore has been completely excavated discolored seams may be observed. These are generally quite conspicuous, both on account of their slightly iron-stained appearance and on account of the resistant character of the material of which they are composed, the latter feature having frequently caused them to project from the softer, unmineralized country-rock. They may be most readily observed in the beds overlying the ore, as these are of slightly lighter color and of a more shaly character than those in which the ore itself occurs; but if carefully followed to the side or end of the stope may be traced downward into the underlying quartzite, shale, or dolomite, whenever mining operations have revealed the rock below the ore. These seams are known to the miners as 'verticals.' In a vertical there are two features to be distinguished: (1) the original fracture; and (2) the mineralization along or proceeding from that fracture. The original fracture is a result of rupture due to strains in the country-rock. It may have been a simple crack with no perceptible open space between the walls or a crevice an inch or more in width. Secondly, as a result of mineralization the fracture is often filled by silicious deposits, and sometimes stands out as a small ridge in softer material, or it may be lined with quartz crystals and not completely filled. Often it is not clearly distinguishable in the mass of the ore. As a result of the replacement of the country-rock on either side of the crevice, a sheet of hard silicious rock is formed which may extend for a considerable distance on either side of the fracture. If extensive it forms an ore-shoot; if slight a vertical. This vertical is often confused with the fracture, but it is important not to confound the two. The fracture admits the solutions and the orebody is formed by them. At times the vertical, which has resulted from the mineralization of a series of parallel fractures, occupies the entire roof of the stope, the space between the individual fractures having become more or less silicified. Simple fractures are generally vertical, or nearly so.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

BUTTE, MONTANA

Prosperity of Butte.—Zinc and Sulphuric Acid.—Oil and Gas.—Explosion at the North Butte.—Apex Litigation.

It is generally conceded that at no time in the history of Butte has there been more real mining or substantial progress than at present. There may have been more easy money for some during the Heinze days and the times of open gambling, but what I refer to is real prosperity, when profit is made by underground work and recovering metals from ore. Of course the profits are not so manifest in a company centre like Butte, as they would be in a district with many small operators; but the money is coming out of the ground just the same, and the local community prospers from the wages earned and supplies sold.

The copper mines are working, not to their capacity, but to the capacity of the smelters; the same may be said of the zinc mines. All could produce more ore, but the smelters are unable to treat a greater quantity. No new ore discoveries of importance have been made recently, but ample reserves were already developed to take full advantage of the high prices of copper and zinc.

The mines may be making no important discoveries, but the smelters have a more cheerful story. Improvements in concentrating and smelting practice are continually being made, resulting in greater recoveries, enabling the mines to deliver lower-grade and more refractory ores than formerly. Something seems to be in the air regarding zinc smelting. The Anaconda company's Washoe smelter, which was busying itself with phosphate investigations a few months ago, has dropped that for the present, and is devoting much time to experiments in zinc smelting. Results must be encouraging, as the company is now developing several of the old zinc properties at Butte that have long lain idle. If the Anaconda smelter succeeds in making commercial zinc from the iron-zinc ores which occur in most of the old silver mines of Butte, an extended life is assured for the district, as there are dozens of large veins now unworked, containing ore of this character. An announcement from the Anaconda company that it is ready to receive pyritiferous zinc ores for treatment would be glad tidings indeed for Montana, as there are many such deposits now lying idle. The Anaconda smelter has been making large profits from one unexpected source; because of the large consumption of acid in the manufacture of explosives for Europe the price of sulphuric acid has risen high, and part of the acid made at Anaconda is now shipped to other markets, although the original intent was to use it locally entirely.

During recent months there has been considerable intelligent drilling for oil and gas carried on in various parts of eastern and central Montana. Large gas wells have resulted near Havre, and it is expected that the gas will be put to commercial use. Domes and anticlines in Cretaceous rocks in other parts of the State have been drilled, but so far without success; an exception to this last statement may be the oil recently struck in a well south of Billings, near the Wyoming line. Drilling near Ryegate and Harlowtown seems to have been intelligently done, but results were disappointing. The wells are usually drilled through the upper Cretaceous, stopping in the fresh-water Kootenai formation of the lower Cretaceous or Comanchean. Drilling is now under way on another dome south of Two Dot in Meager county.

As has been mentioned in two recent issues of the Press, on October 19, 600 lb. of dynamite exploded at the surface station of the Granite Mountain shaft, of the North Butte company. This explosion resulted in the death of 16 men, and the injury of several others, and did some damage to the surface equipment at the shaft. This accident, the worst that has occurred in Butte for many years, if not the worst in the history of the place, is at present inexplicable, and will probably remain so, as all those who were near the scene at the time were killed. The powder in question was in a mine-car, waiting to be lowered and distributed to the powder magazines in the mine. It was the last of several cars of powder which had been sent down. As far as anyone knows, no one was standing near the powder at the time of the explosion, although there were a score of men within a radius of 50 ft. of it. Various suggestions have been offered to account for the explosion, all of which are within the range of possibility, although it is unlikely that the real cause will ever be known. It has been suggested that a burning cigar or cigarette end may have been carelessly dropped into the car; or that something heavy may have fallen or been thrown into the car; or that a high power bullet from some distant hunter's gun may have dropped on the powder; or that some ill intending fellow had arranged a mechanism to explode the powder; or that some imperfection in the powder itself caused the explosion. There seems to be no dependable foundation for any of these theories, and they had best be passed without further comment. In consequence of the accident the operation of the mine is temporarily at a standstill, because it so happened that nearly all the dead men were bosses in varying capacities about the mine. The accident does not seem to suggest any further precautions which might be made in the handling of powder. The powder certainly has to be lowered into the mine, and the present method of handling seems to be adequate and safe. One does not expect frozen powder in transit in a mine car to explode. In fact, most men who work about mines find it necessary to give powder rougher usage than it would have in being transported down the mine in boxes in mine-cars. It would seem that the accident must be regarded as one of those rare and unavoidable misfortunes, which all men must consider themselves subject to, who have to handle or be in the neighborbood of high explosives.

If Julius Caesar could have dropped into the Federal Court in Butte any day during the past three weeks, it is doubtful if anyone there could have explained to him satisfactorily, in a short time, the meaning of the gathering together of so many men of importance and fame in the mining industry. Of course, it would have been necessary to explain to him that they were gathered in two groups on opposite sides of the room for the purpose of emphasizing the fact that they were supposed to think differently upon important questions, which the Judge was being asked to decide. But if Caesar had been sat down beside the Judge (G. M. Bourquin) and made to get his idea of the controversy over the mysteries of apex litigation from the same sources, but without the preliminary experience in such matters that the Judge enjoyed, it is doubtful if he would have been able to make head or tail out of the controversy.

In fact the Judge had to protect himself by asking the litigants point blank, in the early stages of the trial, what the controversy was all about. He knew, of course, that orebodies worth many millions of dollars were the bone of con-

tention, but as to how each litigant proposed to lay claim to these orebodies, the Judge was offered no positive clew, at first. He, therefore, asked both sides to give him a brief and lucid statement, if possible, of the legal issues involved. "For," said he in effect, "if these questions to be decided are purely geological, you have selected the wrong man to decide them; I suggest that the geologists be instructed to go outside and settle their geological differences among themselves, but if legal questions are involved, let these be clearly segregated as far as possible from geological impedimenta, so that the Court may exercise his legal judgment unclouded by technical mystification."

The Judge further asked the litigants to confine their expert testimony to five witnesses on each side, if possible, thus to avoid useless reiteration of the same point on the assumption that the number of witnesses saying the same thing would increase its effectiveness.

Never before has there been a trial of this nature in Butte where so much, and such expensive, evidence has been offered. Besides a long and talented array of expert witnesses on each side, great numbers of carefully prepared plans, sections, sketches, and models have been offered in evidence. Altogether more than 250 exhibits were introduced.

Much interest is being shown in the proceedings, not only by those financially interested, but also by various members of the community at large. The expert testimony offers a rare treat to senior students in the State School of Mines here, and they have been interested spectators at many of the sessions. Mining men and lawyers fill that part of the courtroom set aside for visitors.

The expert testimony has furnished an up-to-date course in geology to the audience. Structural geology, chemical geology, rock genesis, ore genesis, etc., have all been considered by competent witnesses, and under the most favorable circumstances for the layman, in that every effort has been made to present facts in a non-technical manner for the benefit of the Judge.

An unusual phase of the trial deserving favorable comment is the excellence and promptness of the reporting of its proceedings. Two court stenographers alternated in short periods throughout the day in taking down what was said. After one had worked for, say, half-an-hour he was relieved by the other. The one so relieved hurried to a private room and dictated his notes to a dictaphone. The dictaphone records were promptly transcribed by expert stenographers, so that the full day's proceedings were typewritten and in available shape shortly after court adjourned each day. This system was of great assistance to the litigants, as well as to the newspapers desiring to report the proceedings as news.

On the whole, one could hardly call the trial a lively entertainment. Occasionally a clever sally or a bright rejoinder would come out, but the ordinary course of the testimony seemed monotonous to the outsider. Part of this was due to the necessity for exact descriptions and reference to survey-points in describing structure at specified places, but it was mostly due to the halting manner of speech of the careful witness. The glib talker who started his answers before his questioner had finished the question did not prosper on the witness-stand. The halting words of the witness who was trying to be exact and guarded in his testimony made hard work for the audience. In fact, a look of forced interest characterized the countenances of those inside the witness-rail and those outside as the day wore on. The Judge showed more sporting blood in that regard than anyone; apparently he was an attentive listener throughout the entire proceedings, interjecting pointed questions occasionally, and endeavoring to absorb everything that was said.

One is surprised to observe how seriously the Judge takes his responsibilities. As he himself had occasion to state, at one point in the trial, his decision will hardly be accepted as final. The case will be appealed to the higher courts, whichever way he decides, so that a less conscientious man might be inclined to humor himself by the realization that his opinion would not be accepted in any case.

The element of personal interest in the outcome of the trial was not as apparent on the Butte & Superior side as it was on that of the Elm Orlu. The president and the manager of the Butte & Superior were in attendance, naturally, but the real owners of the Elm Orlu were present in the flesh. Both W. A. Clark and W. A. Clark, Jr. attended nearly all the sessions of the trial, consulting and advising with their counsel and expert witnesses as the case progressed.

As is usual in such cases there proved to be a vast difference in the ability of the various experts to convey their thoughts definitely and clearly. For a man who is burdened with his own conceit, and an insufficient foundation to justify his self-esteem, a grilling on the witness-stand is excellent medicine. He finds arrayed against him clever lawyers and experts eager to disconfit him, to dissect his inaccuracies of thought and statement, and flaunt them before the Judge. Nevertheless the trial has been characterized by very little bitterness, or meanness of spirit. Considering the money involved it was rather remarkable that so few personalities were indulged in. Differences of opinion were plentiful enough. In fact, a disinterested observer could hardly believe both sides were trying to tell the truth, so diverse was their presentation of facts. This condition became so noticeable that the Judge finally essayed to see for himself and has agreed to go underground, in order to view certain disputed conditions with his own eyes.

There is no use beating about the bush in the matter; it cannot be gainsaid that the retained witness is prone to be biased in favor of the signature on his pay-check. The better of them will not bear false witness in the narrow sense of the word, but when it comes to fulfilling their oaths and telling "the whole truth," there is frequent room for suspicion. There is an undoubted tendency to put the loud pedal on points favorable to their clients and at least the soft pedal on points unfavorable. Would it not be better to have an independent expert advisor, one who did not care a rap for either side, but whose sole duty was to advise the Court fully and candidly? A case in point came up during this trial. A much mooted question throughout the proceedings was the significance of gouge in relation to the age of the vein. One witness would set his jaw and declare that the gouge showed antecedent mineralization. An opposing expert would declare with equal firmness that the gouge was there first, in fact, the gouge was what controlled the direction of the circulating solutions. The Judge was apparently left pretty much in the air after all this. The facts were but partly made clear to him, that gouges could be pre-mineral, post-mineral, or formed during mineralization; that a given gouge might have been formed under all these conditions, and that in many cases the evidence was not conclusive as to when it was formed, and that it was therefore of little real value as evidence if the experts could interpret it so differently.

The experts at the trial were, as some one expressed it, the "usual bunch," with one or two novices. Western apex-suits are getting to be regarded as unimportant if Finch, Winchell, Wiley, Burch, and Weed are not on hand.

GOLDFIELD, NEVADA

New Producers.—Goldfield Consolidated, Jumbo Extension, Atlanta, Kewanas, Sandstorm-Kendall, Simmerone, Merger, Great Bend, and Other Mines.

The number of producing mines in the Goldfield district has lately been augmented by three, namely, the Kewanas, Atlanta, and Simmerone. The Atlanta has shipped some medium-grade ore in the past, and the Simmerone yielded some very rich ore from surface workings in the early days of the district, but the Kewanas is now starting production for the first time, and from the quantity of medium-grade ore opened, and the similarity of geological conditions to those in the

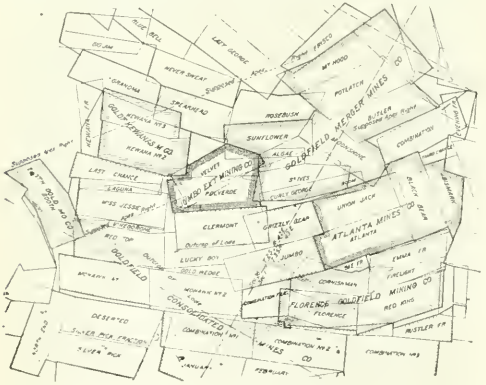
Jumbo Extension ground, those in authority believe a substantial output is assured. There is reason to believe that the time is fast approaching when large quantities of the lower grade, copper-bearing ore of the district will be treated here profitably by flotation.

The estimated production of the Goldfield Consolidated Mines Co. in October is as follows:

Ore mined, tons	36,500
Gross extraction	$256,000
Operating expense	155,000
Net realization	101,000

The tonnage mined and treated by the Goldfield Consolidated in October, 36,500, is the largest for any single month in the history of the company's operations. The principal production is from the Mohawk, Red Top-Laguna, Combination and Clermont mines. The large radial cableway, the installation of which was completed several months ago, has not been used, as it has not been necessary to draw on the tailing-pond to supplement the supply of ore from the mines.

Deeper levels of the Jumbo Extension mine are opening quantities of high-grade ore, both in the shale-contact zone



PRINCIPAL PROPERTIES AT GOLDFIELD, NEVADA.

and in the fissure that extends within the shale. Drift No. 530, the farthest point to the southeast at which the contact-zone has been penetrated, has continued for 170 ft. in ore of uniformly high grade, the daily assay-sheets indicating averages of from $50 to $200 per ton across 4 to 8 ft. Raises from the 1017 and 975-ft. levels have connected with this drift, improving ventilation and facilitating extraction. Two stopes have been opened on the contact ore, at points 100 and 200 ft. above the rich No. 524 drift, or 880-ft. level, on the flat dip of the shale. The first stope, No. 541, is showing ore of excellent grade, faces 4 to 6 ft. wide lately assaying $60 to $350. Production is maintained at the usual rate of two 45-ton cars daily, with occasional additions to this amount. The Velvet or No. 2 shaft is progressing rapidly, and should be completed early in January to the 1017-ft. level, with connections made at the 780, 860, and 1017-ft. levels. Production will then be practically doubled.

Conditions in the Atlanta mine are reported by the manager, A. I. D'Arcy, to have shown decided improvement of late, particularly on the 1580 and 1620-ft. levels, where ore of shipping grade, has been exposed in considerable quantity. A drift on the 1580-ft. level is showing 5 ft. of ore assaying $28 per ton gold, in addition to from 4 to 6½% copper, and a little silver. Stoping has begun in two places and shipments will be made regularly. On all four levels large bodies of lower grade, copper-bearing ore are exposed.

Stoping is now in progress in the Kewanas, at a depth of 840 ft., where a drift has followed the ore-shoot for 160 ft. For about 60 ft. of this distance the drift shows 3 to 5 ft. of ore that can be shipped profitably, averaging around $40 per ton, and containing a small amount of copper. The east cross-cut from this drift exposed the hanging wall, 40 ft. distant, and cut a number of seams of pay ore varying in width from 9 to 30 in. Near the hanging wall a winze is being sunk, timbered to 20 ft., and provided with platforms. The foot-wall has not been exposed. The new winze is being sunk to reach the shale-contact zone, and it is apparent that this will be reached shortly.

At a depth of 700 ft. in the Sandstorm-Kendall, the east cross-cut from the incline winze has progressed over 100 ft., and has not yet exposed the foot-wall of the lode, which is thought to be within 50 ft. of the winze. Seams of medium-grade ore have been cut in this work and a raise will be driven to determine the degree to which the vein has flattened. The winze, sunk at a dip of 70°, left vein matter and has been in andesite from a point 60 ft. below the 500-ft. level.

The orebody found in the Simmerone, in a raise 35 ft. above the 100-ft. level, promises to yield some ore of excellent grade. The raise was continued 14 ft. on the ore, and from here a winze, on a flat incline, is following it down toward the drift on the 100-ft. level, where it will be sought by drifts now being advanced at this depth. H. C. Cutler, consulting engineer for the company, sampled the ore sacked from a shoot averaging 2 ft. wide, and obtained an average of $117 per ton. The foot-wall of this rich seam, for a width of 3 ft., is said to assay $42 per ton when screened. The discovery was made in territory leased for a term of three years from the Blue Bull Mining Company.

Results of work by the Merger Mines Co. have been significant in determining the position and course of the shale-contact zone of silicification south and south-east of the Jumbo Extension ore-channel. The north-east cross-cut from the east contact-drift on the 1175-ft. level has advanced over 200 ft. and passed out of the shale, through a wide quartz zone, containing much iron and some copper, and is now in latite. The manager, Willis Lawrence, explains that his plan is to continue this cross-cut to the contact-zone at the other side of the valley or depression in the shale's surface, farther east and presumably in the Sunflower claim, after which drifts and raises will be driven to explore the two quartz zones. Connection for air will later be made with the Jumbo Extension workings on the 1017-ft. level of the latter, and the workings will be connected with the main or St. Ives shaft of the Merger.

The Great Bend company has completed repairs to shaft timbers near the 400-ft. or bottom level, and a cross-cut has been driven south from the sump, to afford additional sump capacity, also to serve later for development in this direction. Driving is in progress to the east, following the main branch of the lode, for a point 100 ft. distant, below a winze from the 250-ft. level where rich ore was found by early lessees. The surface plant is a duplicate of that installed at the Velvet shaft of the Jumbo Extension and a compressor and jack-hammer drills, with driving columns, have been installed lately.

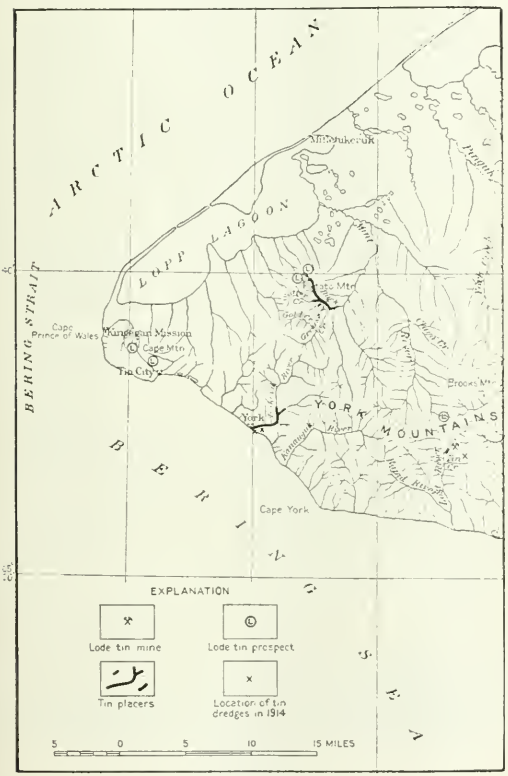
A cross-cut east from the station on the 600-ft. level of the Silver Pick Consolidated has penetrated the main lode and is in quartz of good appearance, yielding low assays in gold. At the west, on the 500-ft. level, drifts are exploring the Phelan vein and show some good mill ore.——The 250-ft. main shaft of the Spearhead Gold Mining Co. is being unwatered and provision has been made for sinking to the shale-contact, an estimated depth of 1000 ft.——Lessees on the Diamondfield Black Butte property have exposed high-grade ore at a depth of 110 ft., and the company is preparing to install a compressor for the use of the lessees.——Work will be in progress shortly on the Vernal, Oro, Grandma, Kewanas Extension, and several other properties here, in addition to the 17 companies now operating and whose stocks are listed.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Since 1902 the output of metallic tin in Alaska amounts to 526 tons valued at $380,006, according to Henry M. Eakin in 'Tin Mining in Alaska,' Bulletin 622-B of the U. S. Geological Survey, of 14 pages and two maps. Most of the black tin was extracted in the York district of Seward Peninsula, north and



MAP OF YORK TIN REGION, SEWARD PENINSULA.

west of Nome. Some tin has been found northeast of Fairbanks. Since 1911 one dredge has worked on Buck creek, while two boats were built on the Anikovik river in 1914 to recover gold and tin together. Lode tin was found at Cape mountain in 1902. A. J. Collier and F. L. Hess of the Survey discovered a lode on Lost river in 1913, and extensive work is underway there. A mill is operated. About 40 men are employed in the tin industry.

Cordova

On account of shortage of vessels copper ore from the Bonanza and Jumbo mines of the Kennecott company is accumulating at Cordova. At present there is 3500 tons averaging 70% metal, and 14 cars of other material, the whole worth $968,000.

In order to cope with the winter traffic the Copper River & Northwestern railroad has ordered a new rotary snow plow and three oil-burning Mikado type engines from the American Locomotive Works, also 15 box-cars of 50-ton capacity from the Seattle Car & Foundry Company.

During the season the Valdez Creek Placer Mines, operating near Broad Pass, purchased 60 acres of dumping ground, doubling the capacity of the hydraulic plant. In No. 2 pit 15 and 18-in. pipe, and two 7-in. nozzles are being installed; also 1400 ft. of Bouery steel riffles in the 5-ft. flume. Other machinery is to be erected. Hydraulicking for the season was completed on October 10, and will resume in May, 1916.

Juneau

September returns of the mines on Douglas island were as follows:

Results.	Alaska Mexican	Alaska Treadwell	Alaska United
Development, feet	184	503	1,096
Stock of broken ore, tons	—10,172	+7,594	—8,932
Stamps dropping	120	540	270
Ore crushed, tons	18,690	80,472	42,994
Gold from all sources	$26,543	$150,345	$69,498
Yield per ton	$1.42	$1.87	$1.61
Operating expenses	22,149	88,252	52,207
Construction charges	1,786	7,929	12,641
Profit	$2,342	$52,661	$3,955

On October 24 the new 30 stamps at the Ready Bullion mill of the Alaska United commenced work; this makes a total of 300 stamps for that mine. It is motor driven throughout. Four double-deck Deister tables are used. The drainage-ditch above the open-cut at Treadwell to prevent water going into the mine, is finished. It is over ½ mile long, and is in rock for some distance.

Valdez

A raise from the 350-ft. level of the Granite mine on Hobo bay has cut the vein, where it is high grade. The property is equipped with two crushers, rolls, 10 heavy stamps, a 7-ft. Lane mill, three tables, etc., also two 80 and one 180-hp. oil engines, one 150-hp. generator, motor-driven compressor, etc. R. W. Millard is in charge.

ARIZONA

Cochise County

The report of the Wolverine & Arizona Mining Co. for the year ended September 30 shows the following: 7610 tons of 6.21% copper ore was shipped to the Copper Queen smelter at Douglas, returning $130,370 net, or $17.13 per ton. Cash on hand amounts to $155,974. Work during the past year was largely confined to exploiting a sulphide orebody, situated in the eastern end of the Warren claim, high up in the mountain above the Higgins adit, which serves as a main entrance for the workings. In December of 1914 an initial dividend of 20c. per share was paid.

During the bombardment of Agua Prieta, just across the border in Mexico, people in Douglas were in danger from the shooting. Schools were closed, and it was possible that the Calumet & Arizona and Copper Queen smelters would be affected.

GILA COUNTY

At Chilito, seven mines north of Hayden, where is the A. S. & R. Co. smelter, a rush has set in for a new gold discovery.

At the Old Dominion, at Globe, the concentrator is treating 700 tons of ore daily, 100 tons of which is from the Arizona Commercial. The mine is producing between 900 and 1000 tons, mostly from No. 12, 14, and 16 levels east and west. The daily output of water is under 6,000,000 gal. The pump motors at No. 18 station are being overhauled. The smelter produced 2,700,000 lb. of copper in October.

Half of the Inspiration mill is at work. Machinery for the remaining nine sections is arriving. The coarse-crushing plant is working well, and both main shafts are in commission. An Otis elevator is used for lowering or raising men in the west shaft. The miners' change-house is making good progress.

According to deputy State mine inspector John Harper, safety work in the Globe-Miami district is giving good results.

GREENLEE COUNTY

On November 4 a parade of over 2000 miners was held at Morenci. At Clifton over 2000 strikers were addressed by J. T. Walker, president of the Illinois Federation of Labor. He urged firmness, without violence. Press news is being censored by the Western Federation.

On November 5 No. 2 and 3 units of the Arizona Copper Co.'s concentrating-plant, the new conveyor-plant, and ore-bins at Clifton were destroyed by fire. Further damage was stopped by dynamiting buildings. The loss is very heavy. The outbreak was mysterious, but officials are non-commital.

MOHAVE COUNTY

The Grand Gulch, Bronzell, and Copper Mountain mines are shipping over 200 tons of high-grade copper ore per month to smelters in Utah.

The Santa Fe railroad is to construct a line from Topoc to Oatman. It will follow the route of the old Mohave and Milltown line, a narrow-gauge logging road abandoned years ago.

Oatman has been visited by J. Parke Channing, who is reported to have said after going through the underground workings of the United Eastern, and an inspection of its properties in the southern part of the district:

"I was agreeably surprised at the showing of the United Eastern mine, although I was prepared to see a big amount. The orebody developed in the property is big and strong, and I am told carries unusual gold-content. The property is entitled to rank among the big gold mines of the country. One cannot obtain much of an idea of such an extensive mining area in a brief 24 hours. Structurally, however, it is obvious that the veins or lodes are of unusual breadth and strength. The camp undoubtedly has great promise, and I shall be surprised if there are not numerous big mines developed here. The region pleases me very much."

The United Western company has cut lode formation at 500 ft., which shows gold on panning.

Oatman is growing at the rate of 50 people daily.

CALIFORNIA

AMADOR COUNTY

At the Allen copper mine, near Ione, three shifts are sinking the shaft, in which is a large flow of water.

ELDORADO COUNTY

Three miles east of Placerville is the Rising Hope gravel mine managed by G. W. Englehardt. During the past five years over 10,000 ft. of work has been done, and the mine is now producing gravel worth $2.50 per car of 1600 lb. The barrel type of mill treats 6 tons per hour. C. M. Hensen is superintendent.

Gravel and quartz mines around Placerville are giving good results lately.——Burr Evans has secured a lease on the Consumnes quartz claims near Omo, south-east of Placerville.——Los Angeles people have leased the old Stillwagon quartz mine on the Consumnes river. It is opened by an 800-ft. adit, and is equipped with stamp-mill and electric power-plant.——At the Judson 'pocket' mine near Diamond Springs three shifts are working. A pumping-plant has been installed.

NEVADA COUNTY

Good progress is reported from the Polar Star mine, and more men are to be employed. The electric hoist and pumps are nearly ready.——The new 10-stamp mill at the Columbia, near Washington, is crushing 50 tons per day.

PLACER COUNTY

The Big Oak mine near Colfax has been unwatered and examined, and the optionees are to commence development. The 240-ft. shaft is to be sunk to 300 ft. A mill is contemplated. F. H. Hubble, J. Toman, and R. C. Chapman of Colfax hold the option.

SAN BERNARDINO COUNTY

(Special Correspondence.)—New developments at Atolia during the past week were the finding of two new tungsten veins. One of these was cut by driving on 60-ft. level of the Skylark claim, an easterly extension of the Atolia company's ground on a lease worked by Brock & Lypp. The vein is said to be three feet wide, half of which will average 60% WO_3. The other discovery was in a shaft several hundred feet north at bed-rock, by P. J. Osdick, owner of the Mascot claim.

Fully three miles from the Atolia area, on the Randsburg road, along the route of the new pipe-line, another important find of scheelite ore was made on October 24. The vein is about 4 to 6 in. wide, and exceptionally high-grade. Bob Tate of Randsburg has acquired a lease on the property, and begun extracting ore from the surface. This latest discovery enlarges the tungsten belt several miles, and establishes an area of 15 sq. miles where scheelite veins are known to be producing high-grade material.

A fire on October 26 destroyed a bunk-room and store-house adjoining the Atolia mill; the loss was about $250. Lack of water and great excitement were the principal characteristics. The mill was in danger for a time.

About 40 new claims were staked by prospectors and promoters between Atolia and Cuddaback lake this week. Several auto parties have been camped in that locality, and some have pitched camp and begun sinking holes to bed-rock.

Owners of the Scheelite group are expecting a Keystone drill which has been ordered from the East. A 90-day contract on lease and option contains provision for constant drilling on the property until January 1, 1916.

Atolia, October 25.

SIERRA COUNTY

Stamps and concentrators are to be ordered by A. W. Copps for the Irelan mine near Alleghany, controlled by the Durston Gold Mining Co. Good ore has recently been opened. The mine is an old producer.

At the Excelsior mine near Forest Hill the second lot of stamps has been erected. Six are now crushing 100 tons per day. Another unit is to be installed.

TRINITY COUNTY

At the Bonanza King there are 30 miners employed. No. 4 adit has cut a rich shoot. The mill is being moved to the mouth of this adit.

TUOLUMNE COUNTY

Control of the Dutch-Sweeney Mining Co. has been secured by W. J. Loring for Bewick, Moreing & Co. of London. The mining company holds options to purchase the Dutch and Sweeney properties near Sonora from J. F. Thompson and C. H. Segerstrom, and the App from the Central Land & Trust Co. of Fresno.

YUBA COUNTY

Another large dredge, No. 15, is to be constructed by the Yuba Construction Co. at Marysville, for the Yuba Consolidated Goldfields Co.

COLORADO

Boulder County

As long as tungsten ore is at $30 per unit the Primos and Wolf-Tongue companies will pay shovelers $3.60, laborers, $4.20, and the $4 and $5 men $4.80 and $6 per day. These are increases of 20%. The Primos company is offering good terms to lessees on its tungsten properties, these being 15% royalty and the market price for ore. Some owners demand 25% and only pay $15 per unit.

A rich tungsten and gold area is reported by A. Graves of Denver to have been discovered in this county, but the situation has not been revealed. Specimens of the ore were shown at Denver.

The Nederland tungsten region is very busy, and the town is full of new people coming and going. Accommodation is scarce. For miles the country has been trenched by prospectors. While many are making money, others are not.

Clear Creek County

(Special Correspondence.)—The Sun and Moon mine on Seaton mountain, has been taken over by the Val Tilborg M. & L. Co. Development is being done through the Newhouse adit, and 2 ft. of smelting ore is exposed, assaying $45 per ton gold, silver, and lead. Nels Holme is manager.

The Gunnell mine on Quartz hill, operated by a local pool of mining men, is yielding ore that is worth $400 per ton. In sinking a winze from the drift off the Newhouse adit a production of $100 per foot is made. Rens C. Schirmer is manager.

Klein & Co., Leasing on the East Lake through the Big Five adit, are shipping on an average of three carloads of $30 ore each week.

Swan, Smith & Co., operating under lease on the Gem, have a large shoot yielding around $40 per ton. The ore vein has a width of three feet.

On the 1200-ft. level of the Old Town, a body 4 ft. wide is exposed that assays $200 per ton in gold. George R. Kimball is manager.

The property of the Almaden Mines Co. was sold last week at sheriff's sale to satisfy a judgment in the sum of $27,596 obtained out of the district court by J. A. Greenfield of Bellaire, O. and George Neill of Topeka, Kansas, the bondholders. The holdings were purchased by the two men in question, who announce that a campaign of development will at once be commenced.

The Mary L. Co., controlling the Mary mine on Bellevue mountain, is being developed. Operations are conducted through the Big Five adit.

Idaho Springs, November 2.

Dolores County

On November 1 the Wellington Mines Co. paid dividend No. 9, amounting to $200,000. From December 1, 1914, to October 1, 1915, sales realized $438,336 for zinc, and $39,681 for lead concentrates, a total of $478,017. The profit was $323,630. Three dividends absorbed $300,000.

Gilpin County

The U. P. R. mill has been treating ore from the Gilpin-Orion mine on Gregory hill; it returned up to 10.11 oz. gold, 16.5 oz. silver, and 8.8% copper.

Lake County (Leadville)

A new station pump is to be installed at the Down Town Penrose shaft. It will be a Providence Engineering Works machine of 2000-gal. capacity per minute, driven at 1800 r.p.m. by a General Electric 650-hp. motor. The machinery will work at 900 ft. depth. Water is now down below 655 feet.

The proper course for extending the Yak tunnel into the Aladdin claims is being investigated.

Lessees in the district are doing well, their work being of great value to the community.

Ouray County

The Mountain King company has opened a body of lead-zinc ore from 4 to 5 ft. wide; also a large flow of water.——High-grade gold-silver ore has been opened in the Ores-Metals property.——In September the Camp Bird treated 2655 tons of ore for a profit of $55,200.

Summit County

During the August quarter the Tonopah Placer Co.'s net earnings were $114,000.

Teller County (Cripple Creek)

The estimated output of the district in October is as follows:

Mills.	Tons.	Average value.	Total value.
Smelters, Denver and Pueblo	4,025	$55.00	$221,375
Portland, Colorado Springs	11,000	20.00	220,000
Portland, Cripple Creek	19,100	2.97	56,727
Portland, Victor	12,400	2.36	28,264
Golden Cycle, Colorado City	43,450	17.00	738,650
Gaylord	1,400	3.00	4,200
Caley	800	4.00	3,200
Total	92,175	$13.80	$1,272,416

The tonnage is the largest recorded.

October dividends were as follows: Portland, $90,000; Vindicator, $45,000; and Golden Cycle, $30,000, while the Cresson and Strong also made distributions.

The drainage-tunnel advanced 305 ft. in October, and the face is 900 ft. from a point under the Elkton shaft.

On No. 11 level of the Mary McKinney 8 to 12 in. of 6-oz ore has been opened; on No. 9 level there is 8 to 10 in. of 5-oz. ore.

On No. 10 level of the C. O. D. mine telluride ore has been cut.

The Isabella property, on company and lessees' account, yielded 1850 tons of $20 ore in October; November may be larger. The company has resumed work at the bottom or No. 15 level of the Lee shaft.

On the evening of November 1 the Gaylord mill was burned to the ground. The fire resulted from an explosion of gasoline, which took place while bullion was being melted.

From the open-cut of the Shoo Fly claim on Womack hill, Stratton estate, Hickman & Co. received $91.40 per ton for 200 tons.

Armed guards accompanied two cars of ore worth $100,000 from the Cresson mine to the Golden Cycle mill at Colorado Springs.

The Colburn mill is treating 60 tons of ore per day from the Ajax mine. Custom and lessees' ore is to be treated.

IDAHO

Shoshone County (Coeur d'Alene)

The possibilities of the Pine Creek district are becoming better understood as the area is investigated. The ores contain antimony, lead, silver, and zinc. After leaving Wallace the first mine on the Pine Creek side of the summit is the Sidney. It has been developed by adits, and contains a good deal of lead-zinc ore.——A half-mile distant is the Little Pittsburg. Zinc ore has been opened.——The Highland-Surprise employs 30 men. A new mill is ready for work.——Near the forks of Stewart and Pine creeks is the Antimony-Silver mine. Adit No. 1 shows 2 ft. of high-grade antimony ore, while No. 2 has 5 ft. The dumps contain 5 tons of high, and 200 tons of second-grade ores.——In the Constitution mine is a zinc ore-shoot 500 ft. long; a lead vein runs parallel to this. All of the above properties are supplied with electric power, and have fair transport arrangements.

At 900 ft. in the Marsh mine at Burke the drift from the cross-cut has cut 18 in. of silver-lead shipping ore. The shaft is soon to be sunk to 1200 feet.

A circular reports that during the three months ended September 30 the Caledonia company, near Kellogg, produced

1560 tons of shipping ore and 2389 tons of concentrate, containing 306,080 lb. lead, 319,500 oz. silver, and 182,783 lb. copper, worth a total of $318,248. The net profit was $193,294, and $234,450 was paid in dividends. The excess payments were drawn from the surplus. Twenty-eight miners were employed one shift for six days per week.

An apex suit is to be commenced on November 16 between the Alameda Mining Co. and the Success Mining Co., the former alleging wrongful extraction of $30,000 of ore.

Mullan men have taken a bond on the Elk company's ground near the Morning and Hunter mines, on Mill creek, for $50,000. The Independence company is the largest operator in this area.

No definite situation has been announced for the Bunker Hill & Sullivan smelter, but it is expected to be near Kellogg. The company is investigating freight rates on smelter products, which may decide the place for the plant.

MICHIGAN

The Copper Country

Copper production in October is estimated as follows by *The Mining Gazette* of Houghton:

Mine.	Pounds.	Mine.	Pounds.
Calumet & Hecla	6,700,000	Superior	323,000
Copper Range	4,500,000	Franklin, Jr.	364,500
Quincy	2,220,000	South Lake	18,500
Tamarack	588,000	Isle Royale	978,000
Osceola	1,638,000	Hancock	190,000
Ahmeek	2,127,000	Victoria	270,000
Wolverine	580,000	Winona	238,000
Mohawk	1,404,000	White Pine	726,000
Centennial	220,000	LaSalle	182,500
Allouez	865,000	Houghton	52,000
Mass	552,000	Lake	187,000

Another furnace is to be blown-in at the Calumet & Hecla Dollar Bay plant in a few days. During one 8-hr. shift last week at the C. & H. No. 4 and 5 conglomerate branch there was hoisted 48 and 51 cars of ore respectively. These hold 7.5 tons each, some coming from a depth of 6000 ft. Contractors on tramming and mining earned $4 and $6 per shift respectively.

Shipments of copper through Portage lake in October amounted to 14,726 tons.

MISSOURI

Jasper County

In *Technical Paper* 105 of the U. S. Bureau of Mines, A. J. Lanza and Edwin Higgins discuss pulmonary diseases among miners in the Joplin district, and its relation to rock dust in the mines. In the 47 pages a variety of interesting subjects are discussed, and all mining men in the region should secure a copy. According to C. M. Harlan of Carterville, a State deputy mine inspector, the sanitary conditions of the mines are 50% better than a year ago. He acknowledged the help of the Bureau.

The annual drilling contest of the Hercules Powder Co. was held at Joplin on November 7, and great interest was shown. Results in past years are 31 13/16, 34 9/16, 35 13/16, 36 3/4, and 37 1/2 inches.

MONTANA

Lewis and Clark County

The Helena Mining Bureau has secured a bond on the Yellow Boy mine in the Unionville district. A wide vein of fair value has been developed, and ore treatment may be commenced in December.

The Head property of 80 acres, in the Scratch Gravel district, has been purchased by T. B. Miller for Helena and Butte interests for $42,000. A fair amount of development has been done, and a great deal is to be started. Six cars of gold-silver ore recently netted $22,000.

Silverbow County

Almost in the centre of Butte is the Anaconda company's Emma zinc mine, which is now being developed after 12 years' shut-down. It has been fully equipped, and is in charge of J. Brennan, well known at Butte. Unwatering is in progress, the water being down to 300 ft. Good ore is expected when mining commences. The company is also unwatering the Nettie mine west of Butte. The shaft is 560 ft. deep, it has been re-timbered to 400 ft., at which depth pumps are working.

In the Elm Orlu-Butte & Superior suit the defense concluded argument on November 4. Judge Bourquin examined the area in dispute on the 8th and 9th, accompanied by an engineer from both sides.

At the Butte & London three shifts are shaft-sinking at the rate of 100 ft. per month in granite. The bottom is at 1100 feet.

The Butte-Ballaklava is shipping at the rate of 7000 tons of 4% ore per month, mostly from 1300 to 1600-ft. levels. A winze is down 90 ft. below the 1600-ft. level. Eighty men are employed. Profits are satisfactory.

NEVADA

Churchill County

At the end of the quarter ended September 30 the Nevada Hills company had $33,158 cash on hand, and net resources of $277,478. Ore reserves are small and profits irregular.

Humboldt County

During October the Seven Troughs Coalition mine yielded gold worth $60,000; November is expected to be still higher. Stopes at No. 13 level show one to four feet of $300 to $1000 ore. The shoot so far is 100 ft. long. The winze below 1400 ft. is down 100 ft. Generally the property is in excellent condition. An extra dividend is expected.

The Rochester Mines Co.'s output in October was $40,000, a decrease on account of several delays. On the 415-ft. level from No. 1 winze in block 2 of the Crown Point the vein is 15 ft. wide, some ore showing gold. The average across is from $20 to $25 per ton. The Nevada Short Line, from Nenzel to Rochester, earned $3733 in October, each month shows an increase. Starting at $1 per ton for ore assaying $20, the freight rate increases 50c. on each $10 in valne. New cars are to be ordered.

Lincoln County

Pioche is busy; companies are shipping more ore than before, there is more leasing than before. Developments at the Prince, Home Run, Atlas, Gold Chief, and others are considered good.

Lyon County

The Nevada-Douglas company, in order to take advantage of the present copper market, is shipping each week several carloads of ore to the Salt Lake smelters. This is being taken from the large high-grade deposit recently uncovered in the Ludwig portion of the mine, and will yield over $1500 per car net, after deducting the cost of mining, transportation, and treatment.

On the north-east slope of Yerington mountain, 9 miles north-west of Schurz and 20 miles from Yerington, is the Yerington Mountain Copper Co.'s property. It is said to be of great promise. A 500-ft. shaft, and three adits, etc., have opened good ore. Further development is under way.

Nye County

Companies and lessees at Tonopah last week produced 10,343 tons of ore worth $212,134.

The Extension shipped bullion and concentrate worth a total of $80,000. September profits were $52,000. Interest underground centres at the 1350-ft. level. The new 20-drill compressor is nearly installed, likewise additions in the mill.

The new shoot at 1200 ft. in the Halifax is attracting more attention than any other development in the district. It will

prove the extension of the Tonopah vein system 1750 ft. beyond the Belmont property.

The apex suit of the Tonopah Victor *v.* the Tonopah Cash Boy company has been settled.

The West End mill treated 1173 tons of ore last week; 904 from the West End mine, 54 from the North Star, 50 from the Halifax, and 165 from lessees at various properties.

Lessees at the Montana are shipping $28 to $35 ore.

SOUTH DAKOTA

Lawrence County

To treat its low-grade tungsten ore, the Wasp No. 2 company is to build a 15 to 30-ton concentrating plant. The high-grade material is shipped direct. On account of the greater depth of mining the gold ore (open-cut work), that assaying less than $2.50 per ton cannot be profitably treated. The mill is only treating 150 tons per day, and 40 men have been paid-off.

Pennington County

The tungsten area near Hill City is extending east, where good prospects are reported.

UTAH

Boxelder County

Early in March there were three men at Promontory Point, 30 miles west of Ogden; now there are 200 miners at work and a busy town is growing. The peninsula, jutting into Great Salt Lake, is 42 miles long and 8 miles wide. Various metals are mined in the mineralized belt, including zinc from the Lakeview company.

Juab County

Tintic mines shipped 116 cars of product last week. Good progress is made by the Tintic Milling Co. and G. H. Dern expects the plant complete on January 1.——Lessees in the Chief Consolidated are extracting rich zinc ore.——Lessees at the Yankee Consolidated are sending occasional lots of 42% zinc ore. The company is preparing another shipment of ore from the new development, assaying 200 oz. silver, 10% lead, and up to $8 gold per ton.

'Process of Mineralization and Enrichment in the Tintic Mining District,' is the title of a paper in *Economic Geology* for April-May by Waldemar Lindgren. From 1869 to the end of 1914 the estimated output of silver, gold, lead, copper, and zinc is $154,166,221. Small quantities of arsenic and bismuth are also recovered. The ore deposits are contained in the monzonite and in the limestones and dolomites north of the monzonite area. In the monzonite there is a system of many veins trending north or northeast, which, however, have yielded only a small part of the production of the district. The deposits in the limestone area are replacement veins generally following north and south fractures, but which also in part follow northeasterly cross breaks or the regular bedding planes of the limestone. The intersection of the cross breaks which dip north-west with the north-south fractures produces a tendency of the shoots to pitch northward. Besides, in a broader way, the shoots in the northern part of the limestone area are found at lower levels than those farther south. The shoots form lenticular masses or a series of detached, pod-like bodies, or pipes, separated by long stretches of lean or barren ground.

Explorations in ore below water-level are so far confined to the Gemini mine, where a winze was sunk from 1650 to 1900 ft., water now standing at 1650 ft. An irregular shoot was followed from 1300 to 1900 ft. Ore found just above and below water-level differed remarkably. The sulphide ore found in this shoot is very rich in silver. It occurs in a breccia of dark jasperoid and dolomite. Much of the jasperoid is similar to the ordinary normal sulphide ore, and contains finely disseminated galena, pyrite, and zinc-blende.

The following conclusions were arrived at from Mr. Lindgren's investigation: (1) The jasperoids along the deposits were formed by the replacement of limestones and dolomites by colloidal silica, which later crystallized to chalcedony and quartz. This is the first depositional phase. (2) The contraction and crushing of the silica caused this material to become brecciated, and the silica of the second phase was deposited in open spaces as colloid silica, which later crystallized to quartz. (3) The development of crystalline barite, galena, and other sulphides accompanied both these phases. (4) During the deep oxidation of the deposits secondary copper sulphides (chalcocite and covellite) were formed at all levels, together with oxy-salts. (5) The gold was concentrated in places at all levels in the copper mines by secondary processes, involving the development of free chlorine and gold chloride. (6) The rich silver sulphides such as argentite and proustite are probably all secondary and were formed during the oxidation.

PRINCIPAL PROPERTIES IN THE TINTIC DISTRICT.

(7) Few data are available to determine the character of the ore below the water-level. But the only shoot opened around the water-level shows a remarkable galena ore, rich in silver, pearcite, spherulitic zinc-blende and marcasite, which clearly was deposited later than other ores in the mine. It may possibly have been formed by descending waters at a time when the water-level stood somewhat higher than at present. And (8) partial oxidation has proceeded in this rich shoot to a depth of 250 ft. below the present water-level.

Salt Lake County

Transactions at the Salt Lake City Stock Exchange during October totaled 1,055,746 shares, valued at $240,027. Developments in the American Fork and Big and Little Cottonwood districts, an area of 5 by 10 miles, continue to be of importance; ore production is increasing. The Alta Tunnel & Transportation Co.'s adit is in 1615 ft. in promising formation.

In the last Bulletin of the A. I. M. E. the disseminated copper ores of Bingham canyon are discussed by J. J. Beeson of Stanford University, California. The paper covers 46 pages, including nine plates.

The Ohio Copper mill is treating about 2000 tons of ore daily, with a monthly output of 600,000 lb. The property is leased to the General Exploration Co., which pays at present a monthly royalty of $15,000. The royalty is based on the current price of copper.

Summit County

Striking miners at the Silver King Coalition are returning to work, although the question of insurance has not been agreed upon yet.

Tooele County

In the Mercur district the M. & P. Gold Mining & Milling Co. is enlarging the filtering capacity of the cyanide-plant. About 125 tons of low-grade ore is to be treated daily. Arthur Murphy is in charge.

WASHINGTON

Kittitas County

Seattle people have formed the Millvick Milling & Smelting Co. to operate a property 35 miles from Roslyn, from which rich ore is to be shipped. Reduction works are contemplated. W. A. Burr is in charge.

The coalfields of this county are the subject of Bulletin No. 9 of the Washington Geological Survey, by Edwin J. Saunders. With illustrations, plans, and maps it covers 204 pages. The area lies at an altitude of from 2000 to 4500 ft. In 1913 the output of coal was 1,334,155 tons, out of a total of the State of 3,877,891 tons averaging $2.38 per ton. The Rosyln district was recently represented at the Panama-Pacific Exposition by a mine-rescue team.

Stevens County

According to V. W. Brasch, mining properties in the Cedar Canyon district in the southern part of this county are being actively worked, more so than during the gold rush years ago.

Spokane County

During October, mining companies in which Spokane capital is interested, distributed $1,344,156 in dividends, making $7,706,790 for the year and $71,023,069 to date from mines in British Columbia, Idaho, Montana, and Washington.

According to J. P. Graves, in a talk before the Spokane Chamber of Commerce, that city of over 100,000 people would have remained an agricultural centre of 25,000 had it not been for its mining interests in the contiguous territory. Larger growth is predicted.

CANADA

British Columbia

September profits of the Standard Silver-Lead company at Silverton were $88,057. At the end of the month the surplus was $224,779.

At 900 ft. in the Payne mine at Sandon two feet of high-grade lead-silver-zinc ore has been cut. This mine is an old producer.

Ontario

On December 1 the Dome Mines company will pay its second dividend of 5%, equal to $200,000.

At the Lawson claim of the La Rose company, 30 men are engaged in extracting 'plate' silver from near the surface. In the mine, exploration is under way from the new shaft at 350 ft. depth. Old pillars and dumps continue to supply a fair quantity of ore.

MEXICO

Sonora

One ton of scheelite arrived at Douglas last week from the Esperanza mine, in the Lampazos district; it is worth $38 per unit. The shipment was rushed through Villa territory on burros. The mine is owned by J. S. Douglas and others. According to superintendent, G. Burkart, a mill and power-plant will be erected when the country is quiet, where at present no properties are working except El Tigre, and food is almost unobtainable.

It is said that Villa demanded $25,000 each from the Greene-Cananea, Moctezuma, and Tigre companies, otherwise he would destroy their plants. The first named paid $20,000 in silver.

PERSONAL

H. A. Guess is in Chile.

Richard A. Parker is at Butte.

J. V. N. Dorr is in San Francisco.

Arthur W. Jenks is in British Columbia.

Llewellyn E. Humphreys is at Oatman.

Thos. H. Leggett is here from New York.

H. Vincent Wallace is in Newfoundland.

Frank H. Probert leaves for Oatman today.

W. R. Van Liew has returned to the Caucasus.

W. J. Lakeland is expected here from London.

E. C. Morse has returned to Portland, Ore., from Alaska.

E. C. Homersham has left England, proceeding to the Rand.

Joseph T. Terry, Jr., has been conducting flotation tests at the Magma mine, Arizona.

Walter H. Wiley is one of the expert witnesses in the Elm Orlu case at Butte.

Henry K. Klingender has gone to Oatman, Arizona, from Salt Lake City.

J. Parke Channing visited the Oatman district, Arizona, during the week.

Dorsey Hager has changed his address to 216 Lynch Bdg., Tulsa, Oklahoma.

Roscoe F. Allen is returning to Montana from the Rosario mine in Honduras.

Louis S. Cates is on a visit to the Nevada Consolidated mines at Ely, Nevada.

Charles MacC. Anderson, owner of the *Mexican Mining Journal*, is at Chicago.

R. M. Raymond has gone to London, expecting to return to New York in December.

W. H. Aldridge is at the Mason Valley mines, Nevada, but is expected here next week.

Ben. S. Revett was at Oatman, Arizona, last week, and has now returned to San Francisco.

Benj. F. Tibby has opened a petrological laboratory at 4 Caithness apartments, Salt Lake City.

William C. Russell has taken the management of the Carriman Mining Co. operating the old Caribou property in Boulder county, Colorado.

W. R. Thurston has been appointed manager for The Mine & Smelter Supply Co.'s Salt Lake City branch. F. E. Marcy, former manager, will still be associated with this company, devoting his efforts to the selling and developing of the Marcy ball-mill.

Schools and Societies

The number of students registered at the College of Engineering of the University of Illinois on November 1 is as follows: architecture, 166; architectural, 164; ceramic, 65; civil, 196; electrical, 257; mechanical, 242; mining, 30; municipal and sanitary, 28; and railway engineering, 44; a total of 1192. This does not include the number of engineering students registered in the Graduate school. The classes included 337 freshmen and 255 seniors.

The program (subject to revision) of the meeting of the Columbia section of the A. I. M. E. at Wallace, Idaho, on November 19-20, is as follows: technical session on first day: 'Progress in Ore Dressing,' by D. W. Buckby, and discussion; 'Mine Accounting,' by J. E. Chapman, and discussion; 'Zinc Smelting and Smelter Rates,' by W. E. Henry, and discussion. On the second day there will be a trip to the Interstate, Tamarack, and Success mines, a business session, an election, and banquet. A special invitation has been extended to the Montana section.

THE METAL MARKET

LOCAL PRICES

San Francisco, November 11.

Metal.	Cents per pound.
Antimony	37
Electrolytic copper	19
Pig lead	5.40— 6.60
Quicksilver (per flask)	$100
Spelter	17
Zinc-dust, 100-kg. zinc-lined cases	25

There is no spot market for zinc-dust, and delivery in May next is quoted as above.

ORE PRICES

Antimony: market irregular, 50 and 60% products, free from deleterious impurities, per unit.....$1.60 and $2
Magnesite: per ton $30
Manganese, 50% metal, 8% silica, per ton..... 12
Molybdenite: 90% MoS_2, per pound..... 1.50
Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....$35—40

New York quotes $41 per unit for 60% tungsten ore, prompt delivery.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, November 11.—There has been heavy buying of copper; lead is very strong and active; zinc is firm on recent buying; sheet zinc is up to 17 cents.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov. 4	50.00	Sept. 29	49.29
" 5	50.00	Oct. 6	49.64
" 6	49.87	" 13	49.55
" 7 Sunday		" 20	49.53
" 8	50.12	" 27	48.91
" 9	50.12	Nov. 3	49.37
" 10	50.00	" 10	50.02

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

Silver is higher, and apparently stronger than for some months. On November 6 the steamer to China took metal worth $587,700, say 1,175,000 oz., from San Francisco. The Nipissing company at Cobalt shipped 327,223 oz. to London last week. Stocks in London are 15,000,000 oz. India and China are small market factors at present. English and Continental coinage has steadied the market.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Nov. 4	18.00	Sept. 29	17.87
" 5	18.00	Oct. 6	18.00
" 6	18.12	" 13	18.00
" 7 Sunday		" 20	17.87
" 8	18.12	" 27	17.79
" 9	18.12	Nov. 3	17.89
" 10	18.12	" 10	18.08

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended October 23 totaled 15,229,219 lb., worth $2,832,827. France took 5,341,186; Italy, 4,356,061; England, 3,198,999; and Russia, 1,680,857 lb. Imports amounted to 2,414,325 lb., valued at $365,717. Brass exports for eight months total $26,602,575, compared with $4,559,204 in 1914.

Michigan mines produced 24,900,000 lb. in October, the same as the Anaconda company.

Kennecott produced 10,000,000 lb. in October, with $1,300,000 profit.

Cerro de Pasco is yielding at the rate of 60,000,000 lb. per year.

East Butte is making $2,000,000 per year, equal to $4.75 per share. The debt of $500,000 will be paid on December 1.

ANTIMONY

Quotations are unchanged at 35 to 36c., duty paid, and some fair-sized sales have been made at these high prices. Some of these have been on foreign account, especially to Canada, although domestic munitions makers have been buyers also. A good deal hinges on the opening of the Panama Canal as to when the market will become easier.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Nov. 4	15.25	Sept. 29	14.23
" 5	15.30	Oct. 6	14.37
" 6	15.50	" 13	13.55
" 7 Sunday		" 20	13.37
" 8	15.75	" 27	14.12
" 9	16.00	Nov. 3	14.92
" 10	16.00	" 10	15.63

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

Eight months' exports total 159,839,567 lb., worth $16,419,720, against 8,869,528 lb. and $596,225.

It is reported that the Anaconda company is to erect at Great Falls a zinc smelter of 40,000,000 monthly capacity.

Zinc-ore prices at Joplin were higher last week. The output of the region was 6322 tons blende, 263 tons calamine, and 832 tons lead, averaging $90.23, $61.38, and $56.09 per ton respectively. Total value, $633,555.

The American Spelter Corporation has entered the field of production and selling metal. It owns no mines, but buys ores for its smelter at Kusa, Oklahoma.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov. 4	5.00	Sept. 29	4.50
" 5	5.00	Oct. 6	4.50
" 6	5.00	" 13	4.50
" 7 Sunday		" 20	4.50
" 8	5.00	" 27	4.75
" 9	5.00	Nov. 3	4.87
" 10	5.15	" 10	5.02

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

The St. Joseph Lead Co. will pay a quarterly dividend of 15c. and an extra of 10c. per share on December 15.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Date.	Week ending		
Oct. 13	92.00	Oct. 27	93.00
" 20	92.00	Nov. 4	97.50
		" 11	100.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

New York jobbers are asking $105 to $110 per flask. The Nevada Cinnabar Co. sent 285 flasks to New York last week.

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is strong at 36.50 to 37.50 cents.

At the present income the American Zinc, Lead & Shelting Co. is earning $50 per share.

The Butte & Superior earned $11 per share in the third quarter, against $4.25 in the previous one.

Aluminum in New York is quoted at 54 to 57 cents.

Eastern Metal Market

New York, November 5.

The entire market has been good during the past week, both as regards activity and prices. All the metals are higher, and are showing considerable strength. Their course is more like that in iron and steel than has been the case in recent weeks. Copper was sold in large volume, especially Lake, the producers of which booked business heavily and did not scare consumers by advancing prices too rapidly. Later electrolytic became active. Zinc has advanced both at London and New York, and a large business has been done. The demand for galvanized sheets is brisk, prices have been advanced, and this will mean an outlet for prime Western spelter. Lead is holding firm at a new quotation of 5c., New York. Tin is moving well, and the New York quotation has touched 36c. Antimony is steady at the new high level. Aluminum continues scarce and strong at around 55 cents.

The boom in the steel trade is reaching gigantic proportions. In the production of pig-iron October broke all records, inasmuch as the daily output exceeded 100,000 tons. The production of coke iron in the 31 days of October was 3,125,491 tons, a monthly total never equalled before. The steel companies produced at the rate of 73,595 tons per day, their total for the month being twice that of January. Demand for foundry pig-iron, which has lagged behind that for steel, is now developing fast, and its prices are advancing. Bars, plates and shapes are technically quoted at 1.50c., Pittsburg, but in every district big premiums over this base are being obtained, and the consumer is lucky if he finds a mill that will accept this order at any figure. Added to the enormous business originating from war sources, from other foreign demand and industrial requirements, are the needs being made known by the railroads. They are fast placing orders for locomotives, cars, and rails. The Pennsylvania railroad has placed 175,000 tons of rails for 1916 delivery. Needless to say, prices of miscellaneous steel products such as pipe, nuts, bolts, rivets, etc., have advanced substantially.

COPPER

It is more than ever apparent that in the closing days of October a big business was done in Lake copper at about 17.87½c., cash, which was the price quoted for electrolytic, also. The Lake producers pursued what the trade considers a wise course, in that they did not immediately raise their prices when the buyers came in the market strong, but continued to book orders until commitments for several million pounds were on their books. It is conceded that there is good money in copper at 17.87½c. Early this week producers of both Lake and electrolytic were asking 18 to 18.12½c., cash, but it was pretty well understood that they would accept ¼c. lower. Now they are asking 18.12½c. full terms. A notable feature of the situation is that second-hands either have little copper to offer, or are holding tightly what they have. They evidently do not consider that the time for profit taking has arrived, and this is significant in view of the fact that it is as students of the market that they live. At the present time there is a good volume of inquiry, both domestic and foreign, before the trade, the bulk of it, of course, coming from the manufacturers of munitions. Electrolytic at London has gained £1 in the past few days, and now stands at £89. Discussing the London market at October 15 it is stated that the total supply of copper in Europe on October 16 (German supply estimated) amounted to 28,940 tons, against 34,106 tons on September 30, and 37,275 tons on September 15, indicating a gradual decrease in stocks. October exports showed a betterment, amounting to 23,657 tons. Total exports since January 1, 1915, (10 months) exclusive of Southern and Pacific ports, amounted to 210,320 tons, against 313,064 tons in the same period of 1914, a falling off of 102,744 tons.

Contracts involving upward of 50,000,000 lb. of copper were closed on November 5. It is understood that the metal will be used in the electrification of the Chicago, Milwaukee, & St. Paul Railroad system, and the deliveries will run well into next year. The British government purchased about 8,000,000 lb. for war purposes. In both purchases electrolytic predominated. The prices paid ranged from 18 to 18.12½c., 30 days, delivered. The heavy business caused quotations to advance to 18.25 to 18.37½c. full terms.

An important development in the copper field is the selling of the metal in Great Britain by the A. S. & R. Co., direct from stocks maintained in London, and through its own selling representatives. In New York the Baltimore Copper Smelting & Rolling Co. is selling sheet copper direct from its warehouse.

ZINC

This metal has advanced both at London and in New York. The London market advanced £2 October 28 to £70 10s.; on the 29th it rose another £1 to £71 10s.; November 1 to £73, while on the 3rd it went to £76, or over 15.50c. It is now £77. The New York market advanced with the higher prices abroad, and at all times there was a fair amount of business. The best trading always is done on a rising market, although it must be admitted that in this case there is a large amount of feeling over the prices of spelter. With spot metal about 15.12½c., November 3, prompt deliveries of prime Western were quoted at 14.75 to 15c.; December at 14 to 14.50c., and January 13 to 13.50c., and February and March at 12.50 to 13 cents.

It is likely that less will be said about over-production in the next few months. Winter weather, which is not far off, is not conducive to full operation at the mines or smelters, while it also is pointed out that many of the retorts have been overworked, and must shut down for repairs. Brass-mill special and the other high-priced grades are declining, but the brass special commands ½ to 1c. premium. One reason for the easier state of choice grades is that foreign specifications for cartridge metal are less strict. October exports totaled 6164 tons.

Sheet-zinc has risen to 17c. f.o.b. smelter, 8% discount for cash, carload lots.

LEAD

The action of the A. S. & R. Co. in advancing its quotation $3 per ton, or to 4.90c., occasioned genuine surprise in the trade, for, while the market bore a superficial appearance of strength, it was known that second-hands and the smaller producers were shading prices. The price went to 5c., New York on November 4. The independents followed the leading interest, and at present the market is firm. The advance stirred the interest of domestic consumers, and some of them began to sound the sellers, evidently in anticipation of another advance. Some large foreign sales have been made. London reports that large quantities will be shipped to Archangel before the close of navigation, while inquiries for shipment *via* Vladivostock are in the market. Exports from Atlantic ports in October totaled 4106 tons.

TIN

Deliveries into consumption in October were large, amounting to 4900 tons. Deliveries since January 1, 1915, aggregate 40,575 tons, against 37,200 tons in the same period of 1914, an increase of 3375 tons. In stocks and landing at the end of the month was 2144 tons, while the quantity afloat was 5543 tons. The arrivals at Pacific ports, destined for the East, amounted to 500 tons. In the last few days of October prices started on an upward trend, and 35c. was reached on October 29, while on November 1 and 2, the quotation was 36c. The market here and in London is sensitive and responds to the slightest fears.

MINING DECISIONS

Mining Contract—False Representations

Where a plaintiff sought to recover a payment made on a purchase of a mine, alleging as grounds for recovery a false representation made to induce his purchase, to the effect that a certain vein existed at a certain level, it is sufficient that he show that the vein did not as a matter of fact exist there, and testimony offered by the defendant as to the value of the mine was wholly irrelevant and properly excluded.

Cohen *v.* Stockton (California), 151 Pacific, 741. Aug. 27.

Oil Lease—Forfeiture Denied

An oil lease contained a provision that if oil were discovered, the lease should become effective for 25 years. The assignees of the lessee drilled a well and discovered oil, but afterward discontinued operations owing to the failure of the supply. In a suit by the lessor to cancel the lease it was held that the condition of the lease was satisfied when oil was discovered, and that a mere discontinuance of operations for a period of six months did not constitute an abandonment of the lease or warrant a forfeiture.

Fisher *v.* Crescent Oil Co. (Texas), 178 Southwestern, 905. June 26, 1915.

Coal Lease—Provisions Construed

Under a lease granting the right to mine and remove all coal and veins of coal upon certain property, requiring that pillars of coal should be left sufficient to support the roof so that at the expiration of the lease the mines and improvements would be in good condition for future mining, the lessee was held entitled to remove the coal in the pillars after he had mined all the other coal, as the only purpose of the restriction would then have been subserved, namely, to preserve the property as a workable mine so long as there was any coal to mine.

Miles *v.* N. Y. S. & W. Coal Co. (Pennsylvania), 93 Atlantic, 397. July 3, 1915.

Mineral Rights—Title by Prescription

Where an owner of the surface who was also one of the tenants in common of the mines and minerals therein, conveyed the whole of the property to one who recorded his deed, took possession of the entire property, and by himself and his successors continued in exclusive possession under such claim of title for more than 20 years prior to petitioner's acquisition of title thereto, and operated the only mine on the property, the petitioner as successor in interest had a perfect title to the whole of the premises by adverse possession, as title to mines and minerals may be acquired by adverse possession, not only by the surface owner, but by one having no interest in the surface.

Couch *v.* Armory Commission (New York), 154 New York Supplement, 945. August 25, 1915.

Mining Partnership—Dissolution

A grubstake agreement provided that the partner furnishing the capital should have an undivided quarter interest in mining claims in Alaska, and on the same day a deed was executed to that partner conveying an undivided one-fourth interest upon certain considerations. Thereafter the working partners assigned their interest to others, who upon a suit for dissolution and accounting, brought later by the grubstake partner, sought to exempt their interests from levy for indebtedness. Held, that all indebtedness should be paid from partnership assets and the several interests charged on the basis of their proportionate indebtedness at the date of the levy. Upon distribution the partners were to share equally.

Lesamis *v.* Greenberg (Alaska), 225 Federal, 449. Aug. 9.

BOOK REVIEWS

Field Analysis of Minerals By G. D. McGrigor. P. 86. *The Mining Magazine*, London, 1915. For sale by the Mining and Scientific Press. Price, $1.

Quick and reliable methods of field analyses are often required, and in this book of pocket size, intended for the prospector, mining engineer, traveler, and student, should be found many useful tests. The author thinks that some of the methods might shock those who work in proper laboratories, but as they served him well, they will be found of practical use in the field. Apparatus necessary for the work is detailed; so is the appearance and physical properties of minerals. The use of the blow-pipe, which is one of the author's principal methods of determination is given considerable space, including the reactions. Simple wet analyses are described, and a summary of reactions with hydrochloric acid. Generally a handy little reference book.

Mechanical Drawing. By James D. Phillips and Herbert D. Orth. P. 278. Ill., index. Scott, Foresman & Co., Chicago and New York. For sale by the Mining and Scientific Press. Price, $1.75.

This work is primarily a class-room textbook. Directions for the drawing of 'plates' are given with the text and an outline for a course in mechanical drawing is given at the end of the book. The first chapter is devoted to a brief treatment of 45-degree perspective drawing, so brief that the average student would have great difficulty in comprehending the subject without the guidance of a skilful instructor. The general principles of orthographic sketching are then discussed. The mechanical details of drafting are then considered, beginning with pencil-work, and then tracing and blueprinting. Instruments and materials of drawing are then discussed, and then the various signs and other conventions in common use. A chapter is devoted to lettering and one to 'Advanced Drawing,' the latter dealing with the preparation of complete working drawings of several rather complicated machine parts. Some space is also devoted to isometric drawing, and the last chapter gives some suggestions to instructors using the volume as a text book.

Dana's System of Mineralogy. Third appendix to sixth edition. By William E. Ford. P. 87. Illustrated. John Wiley & Sons, Inc., New York, 1915. For sale by the Mining and Scientific Press. Price, $1.50.

This volume completes the well-known work to 1915. The sixth edition was published in 1892, with the first and second appendices in 1899 and 1909 respectively; the third covers a period of six years. Generally, the new work is similar to the previous ones. That investigators in mineralogy have been active during the last six years is evidenced by the size of this appendix, as well as by the fact that about 180 new mineral names have been proposed. Of these minerals which have received new names about one-third are apparently well established species. The others are clearly to be considered as varieties of already well-known species or, because of their incomplete investigation, must for the present be considered of somewhat doubtful authenticity. The division of the new names into the three classes: (1) of varieties, (2) of doubtful species, (3) of established species, is indicated by the three kinds of type used in the classified list to be found in the book. A bibliography of important volumes published during the period is given. In this term the most important new development in mineralogical investigation is the use of X-rays in studying molecular structure of crystals.

NEW MACHINES AND DEVICES

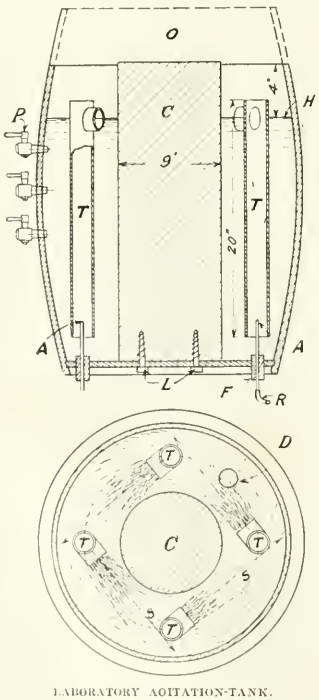
Information based on letters and catalogues from manufacturers.

Laboratory Agitation-Tank

A tank equipped to use the Parral system of agitation, and of a size suitable for laboratories or small test-plants, may be cheaply made from an ordinary wooden barrel, as shown in the accompanying illustration, which is an acid-proof tank for experiments in leaching of copper ores:

O. Is the top portion of the barrel, about 5 or 6 in. to be cut off.

C. Is a central filler made round from a solid piece of 10 by 10 in. timber. The object of this is to take up space in the



LABORATORY AGITATION-TANK.

tank so as to reduce its holding capacity, and therefore the necessity of pulverizing so much pulp for a test. A barrel equipped as shown has a holding capacity of 60 lb. of pulp, with 120 lb. of solution.

T. Is the transfer-pipes, which in acid-proof tanks are of 2-in. lead pipe.

A. Is the lead pipe air-nozzle. This is inserted through a wooden plug F, which drives snugly into holes bored in the bottom of the tank, the lead nozzle extending up about 2½ in. into the transfer-pipes.

R. Is a rubber connection wired on to the air-nozzle. This connection extends upwards to the iron air-pipe placed above the pulp-level H.

P. Is the wooden plug-cocks which are fitted staggered into the side of the tank at various heights for drawing off the clear pregnant solution, when the solids are settled on the bottom of the tank.

D. Is a plugged hole in the bottom of the tank, through which the treated charge may be drawn off.

The tank is set on a rock about 18 in. above the floor for convenience in making the bottom connections, and drawing off the charge. Similar tanks with slightly different equipment suitable for making cyanide and oil-flotation tests may be made. Detail plans for the construction of experimental tanks of any size suitable for testing ores by either acid leaching, cyanidation, or oil flotation will be furnished gratis by the Parral Tank System of Agitation, I. W. Hellman building, Los Angeles, California.

Commercial Paragraphs

CHARLES HARDY has established a business at 50 Church street, New York, as a broker in antimony and antimony ore, tungsten metal and tungsten ore, copper ore, and other minerals. Mr. Hardy was engaged in this line in London for 12 years. In the course of his business career he has visited 40 countries.

The SULLIVAN MACHINERY Co. announces the removal of its St. Louis branch sales office from 705 Olive street to suite No. 2006 Railway Exchange building, where larger and more desirable quarters have been prepared. This change will enable the company to give still better attention to the requirements of its customers in the territory served by the St. Louis office.

During the week of November 1 to 6, the OLIVER CONTINUOUS FILTER Co., of San Francisco, has received orders for filters from the following mills: Chichagoff Mining Co., Alaska; Teck-Hughes Gold Mines Co., Swastika, Ontario, Canada; Duquesne Mining & Reduction Co., Duquesne, Arizona; Walker Mining Co., Portola, California; Calaveras Copper Co., Copperopolis, California; and the Federal Mining & Smelting Co., Wallace, Idaho.

In Bulletins L-530, L-531, and L-532, the LAIDLAW-DUNN-GORDON Co., Cincinnati, Ohio, a subsidiary of the International Steam Pump Co., of 115 Broadway, New York, describes its duplex power-driven Laidlaw feather-valve air-compressors (class PF and PF2), single power-driven Laidlaw feather-valve air-compressors (class RF), and gas compressors, gas expanders, and vacuum pumps for the recovery of gasoline from casing-head gas respectively. The compressors are belt driven from electric motors, the drive being short. Details are given of the construction of parts of the compressors. Those engaged in making gasoline from casing-head gas in California and other states will find the third publication of interest.

On October 25, the U. S. Bureau of Mines placed 'duPont Permissible No.1' on its list of explosives permissible for use in coal mines. It belongs to Class 1a, ammonium nitrate, and is permissible only when used with detonators, preferably electric detonators, of not less efficiency than the No. 6. It is manufactured by the E. I. DU PONT DE NEMOURS POWDER Co., Wilmington, Delaware. On November 4, the U. S. Bureau of Mines placed 'Red H No. 8' on the list of explosives permissible for use in coal mines. It belongs to Class 1a, ammonium nitrate, and is permissible only when used with detonators, preferably electric detonators, of not less efficiency than the No. 6. It is manufactured by the HERCULES POWDER Co., Wilmington, Delaware.

EDITORIAL

T. A. RICKARD, Editor

IT'S an ill wind that blows nobody good. The closing of the Panama Canal, by the slide in the Gaillard cut, has caused a congestion of traffic on the coastwise railroads. We have already learned to appreciate the usefulness of the Canal.

BOLIVIA and Peru are both considering the imposition of heavy taxes on mineral and metal exports. A struggle is in progress between the Governments and the mining interests, which are in danger of being crippled by undue exactions.

TALK of "investing" money "on conservative lines" in mining is usually the preface to a wild-cat scheme. The people who know most about mining are aware that it involves risk, but that the risk can be compensated, and sometimes more than compensated, by the gain.

FLOTATION at the Broken Hill Proprietary mine, New South Wales, treated 2,847,815 tons of tailing from November 1903 to May 1915. This yielded 708,149 tons of concentrate containing about 47% zinc. Now, however, that the process is being applied in this country on a growing scale, it is destined to eclipse anything heretofore done in Australia.

J. C. ROBERTS has been appointed to the new chair of Safety and Efficiency Engineering recently established at the Colorado School of Mines in memory of Joseph A. Holmes. The choice is a happy one; it is one of which Holmes himself would have approved strongly. The new professor at Golden has a host of friends in the mining profession, all of whom are glad to note the honor conferred upon him, in fitting recognition of his faithful work in behalf of the safety propaganda.

ASBESTOS is a beautiful mineral, valuable as a non-conductor of heat. The American source of supply is the eastern part of the Canadian province of Quebec. In this issue we give our readers two allied articles on the subject, one by Mr. F. H. Mason, on the technology of the industry, and another by Mr. P. B. McDonald on the mining of the mineral. We may note that promising discoveries of asbestos have been made recently in Trinity county, California.

SPECIAL arrangements for overcoming a large inflow of water in the Commonwealth mine, in Arizona, are described by Mr. Edgar A. Collins on another page of this issue. The article, as is usual with anything Mr. Collins sends us for publication, is eminently practical and useful. The two main points to be noted are that (1) instead of sinking a main hoisting-shaft in the broken wet ground within the vein, an incline was sunk in the closer-grained rock of the foot-wall; (2) a steel-hinged door of special design was placed in the cross-cut, between concrete pillars, to hold back and regulate any extraordinary flow of water, so that the pump might not be flooded. Details of the various pumps, their cost, and their advantages are given. We commend the article to other mine managers.

AMONG the inventors of flotation processes the following describe themselves as American: Hezekiah Bradford, John Tunbridge, Carrie J. Everson, E. B. Kirby, H. E. Wood, D. H. Norris, J. D. Wolf, T. J. Hoover, and E. H. Nutter; on the other hand, the Elmore brothers, H. L. Sulman, H. F. K. Picard, A. H. Higgins, and A. E. Cattermole, are English. C. V. Potter, A. J. F. De Bavay, and E. J. Horwood are Australians. A. P. S. Macquisten is Scottish. John Ballot is an Afrikander, Alcide Froment is Italian, and G. D. Delprat a Hollander.

CARRIE J. EVERSON, one of the pioneers of the flotation process, died at San Anselmo, California, on November 15 last year. We understand that this fact was ascertained recently in consequence of inquiry following the subscription of a fund in Colorado. It was intended to make a presentation to her, in appreciation of her service to the mining industry. Her own patents expired before the flotation process came into vogue in the United States, so that she derived no financial gain from them, although undoubtedly they served indirectly to stimulate the research and invention of others, now collecting royalties or trying to do so. At the time of her discovery, in 1885, at Denver, she was a school-teacher. Her brother was an assayer and it was in his office that she made the observation concerning the flotative action of oil on a pyritic concentrate.

REVISION of the Federal Land Laws as they apply to mineral locations is to be the subject of a meeting of mining men called for December 16 at Washington. This meeting is to be held under the auspices of the Mining and Metallurgical Society of America, with the cordial co-operation of the various mining associations throughout the West. The purpose is to demonstrate to Congress that those engaged in the mining industry earnestly desire a radical alteration of our archaic and discordant mining laws. However, it is not the intention to advocate specific reforms, or to draft any new laws, but to impress upon Congress the feeling of the industry

that something be done, for instance, by the appointment of a commission with power to study conditions in the mining regions and thus obtain the information required for intelligent legislation.

WE take particular pleasure in publishing a detailed and careful article on the cyanide treatment of flotation concentrate, by Messrs. Charles Butters and J. E. Clennell, both of whom are known wherever cyanidation is used for the winning of the precious metals. The results they give represent the outcome of an elaborate series of experiments on ore from the San Sebastian mine, in Salvador. This mine affords an example of operations in a locality far from any smelter to which the concentrate made by the flotation process might otherwise be consigned. As yet the important applications of flotation have embraced base-metal ores in mining districts linked to smelting centres, so that the local treatment of the concentrate has been a problem postponed. It is obvious, however, that in the case of gold and silver mines situated in localities distant from reduction works or relatively inaccessible to railway transport, it will be necessary to devise some method of converting the precious-metal contents of the flotation product into bullion. Therefore such investigations as these made by Messrs. Butters and Clennell are of wide and timely value. We hope that others will follow their example and be equally generous in giving information so useful to the profession.

Alaska Gold Mines

Mr. D. C. Jackling, as general manager of the Alaska Gold Mines, has reported to the shareholders, by means of an interview in the *Boston News Bureau*, that this great enterprise has encountered an obstacle, sufficiently unexpected to cause perturbation in the stock-market. He explains that some delay in the complete fulfilment of estimates has arisen from "an unlooked-for intrusion of low-grade schist on the 5th level." This was a part of the Gastineau-Perseverance mine from which the management "had expected to draw high-grade material with which to sweeten the known lower-grade ores to be mined near the surface." This 'horse' of schist is all the more disconcerting because numerous drill-holes had been driven all around it without detecting the fact that it was there, like a sunken reef in a tropic sea. Well, it does not mean shipwreck or anything like that; it means the vessel will lose a tide in entering port, that is all, but it is a warning to those who navigate the shallow waters of low-grade mining. Up to the end of October the company had treated 900,000 tons averaging $1.25, or 50 cents less per ton than the original estimate. The cost has been 60 cents, or 15 better than the estimate; while the loss in tailing has been 20 cents, against an expected 25 cents. The net result is a profit of 45 cents, in comparison with the 75 cents anticipated. The discrepancy is serious. Just now 5000 tons of ore is being treated daily, sometime next year it is expected to increase the production to 8000 tons per day, equivalent to, say, 2,800,000 tons per annum. This, on a profit of, say, 60 cents per ton, represents $1,680,000 per annum. The stock has sold at $40 during the current year; as the shares number 750,000, this represents a capitalization of $30,000,000, without including the bond issue of $1,500,000, which is convertible into still more stock. To those experienced in gold mining it is not necessary to say that a return of 5½% per annum is quite disproportionate to the risk inherent in this kind of speculation. A mine, even the biggest, is a wasting asset; to win $30,000,000 from the gold-bearing slate at Juneau it will be necessary, at a profit of 60 cents per ton, to mine and mill 50,000,000 tons of ore; at the rate of 2,800,000 tons per annum it will require 18 years to achieve such a result. And then we have not begun to estimate the further time and tonnage required to pay interest on the money involved. That is hopeless on such a basis. To pay 5½% and redeem the capital involved it will be necessary to double the estimated huge production of 8000 tons daily. In other words, a yield of 11% per annum, 5½% as interest and 5½% to apply on the redemption of the principal, on a valuation of only $20 per share—half the recent high price—will require 18 years of production at the present estimated tonnage and profit. And 5½%, of course, is no sort of a yield for a gold mine; all experience shows that 10% net is barely enough. Therefore we conclude that the original capitalization at $10 per share, for 750,000 shares, net was quite reasonable, but that the recent quotation of $40 was ludicrous. This is an example of a common happening, namely, the over-valuation of a splendid mine. More money has been lost in a few good mines than in a multitude of worthless ones, for the sums thrown away on the latter are small as compared with the inflation that befalls mines of extraordinary size or richness. This is due to forgetfulness of the fact that ore does not grow as fast as it is exhausted. Moreover, even when the managers or engineers of a mine take pains not to exaggerate, it appears to be considered proper for brokers and outside promoters to make what statements they please, the result being to transfer the money of the many to the pockets of the few. That is not the object of legitimate mining. We regret that a magnificent mining enterprise, the product of splendid engineering initiative, should have become the usual counter for a reckless share-dealing campaign. For that we blame the brokers in Boston, not the engineers at Juneau. We also blame the public for its gullibility, in face of the known facts of experience and the absence of technical information warranting the kiting of the stock. As Mr. Jackling says, the milling plant is the most efficient of its kind in existence, it represents a concentration of 800: 1 and the application of the special experience obtained by him and his coadjutors in the exploitation of the low-grade deposits of disseminated copper. The technical achievement is splendid, but it did not need another example to prove that over-valuation easily kills the fruitfulness of a low-grade gold mine. That was proved by the big deep-level schemes of the Rand,

where even a profit of $1 per ton afforded a precarious margin for a return on the big sums of money involved. Besides 'horses' of barren rock, there are caves, fires, and strikes to be faced in the course of a long-lived mine. Renewals of equipment and plant cut into nominal profits. Mining is a business subject to the laws of economics, and it prospers best when the engineer is deaf to the share-broker.

Concerning Talk

In a recent issue an observant correspondent undertook to prove that engineers do not talk enough. He argued that most of them were unable to do themselves justice in so far as they lacked the faculty to use words freely for the purpose of arousing the interest of others, particularly possible clients, in their affairs or the affairs they purposed to make their own. Apparently our correspondent considered that engineers fail to make themselves interesting to the non-technical, but highly financial, persons that supply the sinews of war in that industrial arena where the business of mining is promoted. "Talking will enhance the engineer," he says.

This is a new doctrine. Like many exaggerations, it contains a modicum of truth. Let us disregard the irrelevancies and dwell upon the suggestion that engineers should learn to express themselves in a clear and interesting manner to non-technical persons, and that the possession of any ability is enhanced in its practical value when other people are made pleasantly aware of it. Undoubtedly the ability of an engineer to explain a mining or a metallurgical operation to a client is apt to impress the latter with the engineer's powers. And the client won't be far wrong. Clear expression is preceded by clear thinking. Moreover the understanding of any operation or of any problem is furthered by the effort to state it in explicit terms and in logical sentences. An intelligible and pictorial presentment of an engineering operation is an excellent step in the thorough understanding of it, first by the engineer himself, and then by his client. One of the best ways of clarifying one's ideas on any subject is to try and explain it to another person.

Another phase of the question of talkativeness is the intensely human characteristic that in order to interest others one must be interested in them. No man is likely to speak convincingly unless he is keenly aware of his auditor. That means sympathy. The man who talks and gives information is likely to elicit information in return. One of the best ways of gaining knowledge is to give away the little that one has. That is where the talkative man scores, always supposing that he talks intelligently and to some purpose. Secretiveness meets with secretiveness. Moreover, talk gives form to thought as the surf shapes the pebble on the beach. Frank speaking about things in one's mind may lead to the formulation of good ideas and prevent the making of bad blunders. The ventilation of an idea often leads to fresh thought being brought to bear upon it. Two heads are better than one, even if one be a numskull, for the latter may serve as a strop on which to sharpen the edge of wit. When a wise man meets a blockhead, it is the part of wisdom to use the latter as a dull audience and think aloud in the effort to shape an idea or to arrive at a conclusion. The thought when spoken presents itself differently from the form it has while lying half-dormant in the brain. The presence of the blockhead, like the impurity in a chemical solution, may suffice to precipitate the thought into crystalline form.

Owing to diffidence or laziness some engineers talk but little and condemn those that talk freely. They may be reminded that it is speech, and not anatomical modification, that most separates man from the lower animals. It is man's supreme distinction that he can convey thought by words and perpetuate that thought by writing. Some of us fail to know or to be known for lack of this means of intercommunication. Like two castaways at the opposite ends of a desert island we gaze upon the sullen sea of life without cultivating the sympathy and understanding that can only come from a friendly interchange of experiences. Ah, there we have it: exchange of experience! The failure to make that exchange is the greatest engineering waste and the most obvious cause of inefficiency. To prevent that squandering of priceless knowledge, of men, things, and events, it is well worth while to encourage talk, more particularly among engineers, as a brother to a brother; a senior to a junior, to give advice; or a junior to a senior, to give enthusiasm.

The Withdrawn Oil-Lands

The recent organization, in San Francisco, of the Oil Industry Association, which is composed of the Californian oil operators affected by the decision of the United States Supreme Court affirming the Taft Oil-Lands Withdrawal Act of 1909, directs public attention to a crisis in Western mining affairs. This branch of the industry occupies a position of tremendous importance, not only in the commercial life of the Pacific Coast, where crude oil is burned instead of coal as a fuel for generating steam-power, and as a factor in the use of the automobile, whether for work or pleasure, but in the economics of the metal-mining industry, more particularly in the smelting of lead and copper ores. Indeed, nearly all mining operations near any railway benefit from the use of fuel-oil. It is evident that if the production of oil from unpatented lands is to cease, the burden of supplying established markets cannot be sustained by the yield obtainable from the patented lands alone, which, unfortunately, are not of extensive area. The lands affected by the decision are in the San Joaquin valley, which yields 80% of the 100,000,000 barrels of oil produced annually in California.

Crude petroleum is interwoven in a fundamental way with the social and business fabric of the Nation itself, for there has been created in the great Midway oilfield a Naval Petroleum Reserve, embracing 100 square miles and destined as a source of supply for our battleships of

the future. The Navy seems definitely committed to the use of oil-fuel: the results of a single battle in the North Sea last year has left no other choice. Thus the position is already complicated beyond all hope of a simple solution. Therefore the question has arisen, and will probably be projected into Congress during the coming winter, how far should the obligation of the State to the Nation prevail against the commercial interests of a particular State and its related territory? California, out of her abundance, can guarantee an oil-supply that will maintain a naval policy, at least to the extent of the useful life of the ships now built or in process of building, but will not the requirements for national defense formulated by those residing east of the Rocky Mountains prove too much for public acceptance here? This matter of oil reservation is but one phase of the broader question of conservation, embracing all the unappropriated or unexploited natural resources of the Great West; it is the grim spectre that stalks into the deliberations of every public organization west of the Missouri river, whether it be a Governor's conference, a Mining Congress, or the after-dinner talk of an engineers' club.

The immediate cause of this burden of perplexity is the now famous oil-land withdrawal of ex-President Taft on September 27, 1909. It appears that influence had, without avail, been brought to bear upon Congress during the sessions of both 1906 and 1907 to remedy conditions existing in certain oilfields where title was being acquired by agricultural and other forms of scrip entry, in place of the more expensive method of proving the land by drilling and obtaining a mineral patent outright; in other words, to the subversion of the mining law. The continuance and spread of this practice caused the United States Geological Survey to recommend the withdrawal of large tracts in the favored oil-regions pending this further classification, and the passage of additional laws that would protect the petroleum interests adequately. The acquisition, too, by the Pacific railroads, through their land-grant titles, of vast tracts of mineral land contrary to both the letter and the spirit of the granting acts, as well as the patents flowing therefrom, contributed its quota of resentment against the manner in which oil-lands had been lost. Unfortunately the executive act of 1909 came at a time when the consumption of oil had about passed production, following years of depression due to over-production, and when ascending prices had caused a decided expansion in the search for new pools of oil to satisfy the expanding markets. On that day, the now fateful September 27, 1909, the President, with the authority implied, but not specifically given, by Congress, withdrew from all forms of settlement and entry approximately 3,000,000 acres of presumed oil-lands in California and Wyoming, and possibly some other States. The apparent and implied purpose of the Act was in aid of further classification of, and proposed legislation for, these lands. This legislation thus far, in six years, aside from the Pickett Act in 1910, has failed to materialize; the chief result ensuing therefrom being the suspension of the placer-mining law (except where claims were already 'valid' on September 27, 1909) as applied to the acquisition of petroleum lands, a provision that had been specifically enacted some years previously. In February 1915 the United States Supreme Court affirmed the legality of the Taft withdrawal, and thereby confirmed the virtual suspension of the laws governing prospecting for petroleum on the public lands believed to be most favorable to development, though they might still apply to such lands as the Geological Survey had not yet provisionally classified as valuable for oil. To give meaning, however, to the Supreme Court's decision, an Act was passed by Congress ten days later, appropriating $50,000 wherewith to follow up the Government's now legalized oil-interest in California and Wyoming. The suits under way in these two States follow from this last enactment. Thus it would seem that it behooves Congress to give its immediate attention to rectifying an acute anomaly, acute not so much because many oil operators (and indirectly the consuming public) are victimized by the legalizing of the first order of withdrawal, but because of the practical suspension of the laws governing the entry upon, and acquisition of, oil-land.

Some additional lands have been withdrawn by the President since 1909, with the direct authority given by Congressional act (the Pickett Bill of June 25, 1910), and much that was originally withdrawn has been restored to entry—all upon the recommendations of the Geological Survey. At present there are withdrawn in California approximately 1,500,000 acres, and in Wyoming 500,000 acres. Of the area withdrawn in California over two-thirds is patented land and is not affected, and of the remaining third, or the unpatented acreage, only 10%, situated in and contiguous to known oil-fields of commercial importance, is thought to be claimed by oil-operators at this time. So far as the public is immediately concerned, therefore, and so far as the industry is directly involved, the contest is being waged over some 50,000 acres only of real and prospective oil-land (while prospecting over 450,000 acres has been shut off), having a possible value of $50,000,000, instead of the 3,000,000 acres alleged to be at stake. The present production from the lands affected is said to be 1,000,000 barrels per month. A situation, grave in itself has been made more serious by the entrance of the United States Navy with its demands and requirements for oil-fuel. Of the $100,000,000 annual value of California's mineral products, $50,000,000 is credited to crude petroleum alone. It would seem that any difficulty thus threatening to cripple an industry of such magnitude, particularly if that industry be a basic one affecting the free flow of commerce, should and must have the immediate and serious consideration of Congress. The cause of the oil-men who persisted in the pursuit of their assumed rights and are now in an awkward position may have emphasized this crisis, but their cause, a personal one, is of secondary importance to the bigger issue: the need for an adequate, just, and equitable law governing the acquisition of all the unappropriated and unexploited resources of the Great West, the remaining untapped reserves of mineral wealth in the United States.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

The Strike in Arizona

The Editor:

Sir—I have just received your issue of November 6, and the editorial headed 'The Strike in Arizona' has been brought to my attention.

In the volumes emanating from the editorial room of a scientific publication of authority it is fair to expect that, whatever may be the individual opinion expressed, the facts on which it is based shall be unassailable. It is regrettable that through lack of knowledge of actual conditions existing in the Clifton-Morenci district prior to the strike, the assumptions and inferences in the article above referred to are alike misleading.

You state that underground labor is paid as low as $1.75 per day on 13-cent copper. During the depression of 1914, when copper sold for less than 13 cents per pound, it became necessary for the Detroit Copper Mining Co. to reduce its output and economize in every possible manner. In order to maintain its organization and avoid the necessity of throwing a large part of its employees out of work, it was arranged that a reduction of wages below the normal should be made, and all employees were given work four shifts per week instead of six. Under these conditions the wages paid for a 7-hour shift for Mexican miners was $2.36 per day, and for Mexican 'muckers' $1.87, American miners and 'muckers' receiving 50 cents higher pay.

When in February last the market price for copper reached 14 cents a sliding wage-scale was put into effect which increased wages for every one cent rise in the price of the metal. Therefore, when the strike was declared on September 11 Mexican miners in the district were receiving $2.73 and 'muckers' $2.13 per day of 7-hours shift. This scale of wages is higher than that paid in any other purely Mexican camp in the United States.

You state that "the rate of wages might not have precipitated a strike if the cost of living had not been increased to the Mexicans by the fees exacted for hospital and water service, and by compulsion to buy their food and clothes at the company store." Analyzing this statement in accordance with the facts; there was no increase in the hospital fees, the employee paying exactly the same amount to the Hospital Department, namely, $1 per month for a single man and $1.50 for a married man, as has been in force for years. The charge for water service, which is incorrectly assumed to have been paid to the mining companies, remained at $1 per house per month as formerly.

The employees of the large operating companies of the district are not compelled to deal at the company stores, but have the option of purchasing their food and clothing from merchants throughout the district, who are conducting their business independently of any company control. While it is an admitted fact that the store business of mining companies has been a cause of irritation with some employees, due to a lack of appreciation of what the company store means as a factor in maintaining low prices and decent living conditions in mining communities, where there is competition by outside merchants the company store cannot but be beneficial to the wage earner. It has been fully substantiated that in mining camps in the southwest where no company stores exist the prices of the necessities of life are higher than where a large and efficiently managed mercantile branch of the mining company is operated on a reasonable basis of profits. In the case of Morenci the mercantile business is conducted by the Phelps Dodge Mercantile Co., whose financial report of operations is published in detail in the annual statement of Phelps, Dodge & Co., it shows that the net profit to the Company for the year 1914 was 8.38% on the gross sales and transfers.

You make the statement that the Mexicans complain that the wages paid previous to the strike varied under different foremen. This complaint, if made, has not reached headquarters. It is so obviously absurd as to merit but little consideration. In large mining companies such as those involved in the labor disturbance referred to, the foremen do not set the men's rates of wages nor do they have anything to do with the payment thereof.

As regards the ability of the mining companies to pay higher rates of wages, you state "regarding the Detroit Mining Co. not much is known, it being a subsidiary of a much larger corporation, Phelps, Dodge & Co." It is surprising that you should have expressed ignorance regarding this subject, as the annual statements of Phelps, Dodge & Co. are readily available, and the operations of each of its subsidiaries are separately reported. In fact, on reference to your files you will find that you analyzed these operations last spring. The figures shown as net profits from the Detroit Copper Mining Co. for the year 1914 is $602,318. It might be interesting to state that the demands of the Western Federation leaders were for a wage which would have increased the cost of producing copper for that year by $608,000.

Admitting that as always the employees of a large

operating company have grievances, minor or otherwise, which it is proper and just should be given hearing and consideration, it is a fact that in the present case the employees in the Clifton-Morenci district were receiving in August last higher wages than had ever before prevailed in the district, and prior to the organizers of the Federation shutting down the operations of the companies, had made no requests for a meeting with the managers, nor had they presented any grievances whatever.

The controversy between the companies and their employees has been from the inception, and is today, simply whether the district shall be dominated by the influence of the Western Federation of Miners or shall continue as in the past to operate as an open camp. The questions of the wage scale and other minor grievances have been interjected simply for popular effect and to obscure the issue, and do not alter the cardinal principle of union recognition.

I presume the conditions which initiated and the subsequent progress of this strike are absolutely unique in industrial disputes between labor and capital. The mining companies were forced to suspend operations by an active and aggressive minority who terrorized their peaceable employees, and that without having been given an opportunity to even hear, far less discuss, any question of grievance. The mines and reduction plants were picketted and all representatives of the owners were and have been since September 11 refused admission even for inspection. Only by the departure of the managers from the State, through advice of their legal counsel, has violence and outrage been minimized, and the district now remains almost depopulated through the exodus, voluntarily or otherwise, of the law-abiding element of the people.

Any commentary on a political condition which denies the protection of the law to the industry which has so actively developed the resources of the State would be superfluous.

WALTER DOUGLAS.

New York, November 11.

[Of course, we are glad to give space to Mr. Douglas's rebuttal. He makes our statements apply directly to the Detroit company, while, as a matter of fact, we referred to minimum wages paid in another of the group of three mines affected by the strike. Our information came to us at first-hand from a responsible member of the profession recently at work in the district. As to the fees for hospital and water service, Mr. Douglas has mis-read our remark, which was not that these fees had been increased lately, but that "the cost of living had been increased to the Mexicans by the fees" thus levied. The charge for water-service, like other charges, may be small, and it may not be paid to the mining companies, yet it is a source of irritation to ignorant laborers, such as the Mexicans. We believe the statement as to a variation in the wages paid under different foremen is true, although it may not apply to the Detroit mine, as Mr. Douglas states. We hope that the mining companies will succeed in their refusal to recognize the Western Federation of Miners, but we doubt whether the principle of collective bargaining, as regards their own employees, can be ignored successfully.—EDITOR.]

Flotation on Gold Ores

The Editor:

Sir—I was very much interested in the interview with Mr. Butters appearing in your issue of August 21, 1915.

Flotation promises in the future to take a very important part in the treatment of sulphide gold ores. It is going to be a serious competitor to the cyanide process, especially where the precious metals are locked up within the sulphides. At the present time there are many mills treating low-grade gold ores in California, Alaska, and Korea that employ only amalgamation and water-concentration (tables and vanners), the tailing being too low for a further profitable treatment by cyanidation.

Concentration results will no doubt in the future be improved by the application of flotation to the treatment of the slime. The extraction of sulphides from the sand can be done cheaply and efficiently on Wilfley or Card tables. The weakness of water-concentration methods during the past has been with the treatment of that product passing a 200-mesh screen commonly called 'slime.' The best concentrators on the market today make only an incomplete saving of the fine float sulphide mineral which in many cases accounts for a good part of the gold escaping in the final tailing. Flotation is the remedy. The Suan gold mine in Korea is an example.

There are a number of low-grade sulphide ores (Oriental Consolidated in Korea and the Alaska Treadwell) that do not require to be crushed finer than 25-mesh in order to free the sulphides from the gangue. Would such a coarse product, where a considerable portion of the sulphide remains on a 40 or 50-mesh screen, be suitable for an all-flotation process? I am inclined to favor in such cases a combination process consisting of tables for sand and flotation for slime.

Where the sulphide minerals are finely disseminated throughout an ore and comparatively fine grinding is necessary, I should think an all-flotation process would then be in order. However, those of us who have to do with the design of plants would insist upon large-scale tests before deciding on a flow-sheet. It is money wisely spent where big sums of money are involved in the final plant.

A. E. DRUCKER.

La Salada, Colombia, October 9.

ANTIMONY is being mined in Bolivia, stimulated by high prices, to the amount of several hundred tons monthly of 60% ore. The deposits are irregular veins in slate, and the mining methods are crude, consisting in extracting what can be seen, regardless of the future. Practically no capital has been invested in operating the mines, native methods being employed.

Handling Drill-Steel

By P. B. McDONALD

The old method of handling drill-steel at a mine, namely, getting the dull steel to the sharpening-shop on surface and the sharp steel to the miners underground, was careless. As little attention as possible was spared for this purpose. In some cases, each miner carried his dull steel to the shaft when he went up at half-shift, took the bundle up on the cage, and carried it to the blacksmith-shop; the sharpened steel he carried back in the same manner.

There are many objections to this primitive method:

1. A miner should have as many miscellaneous worries removed from his shoulders as possible; his job is to mine, and he has enough to do if he does that well.

2. It is dangerous for men to crowd into a cage when each has an armful of drills to carry; a stray drill sticking into the shaft may wreck the cage.

3. If the shop is quite a distance from the shaft, as it frequently is, the task of carrying a dozen lengths of drill-steel there, perhaps through snow or rain, is exhausting to a man in wet or thin underground clothes.

4. When a miner has to carry his own steel, he will continue to use dull drills as long as possible rather than change, thus working with poor tools.

Another method of collecting and distributing steel is to have one or more 'drill-boys' make the rounds of the mine, hoisting and lowering the steel without danger of accidents, in much the same manner as 'powder-mongers' distribute explosives underground. There is not so much objection, however, to the miners carrying dull steel to the shaft underground and sharp steel from the shaft to their places of working, so long as that is the limit, because they have to walk in and out to these places anyway. Where the mine has but a one-compartment shaft, it is a good plan to utilize the lunch-hour or any periods of time between shifts to have the drill-steel raised and lowered.

Among the aids to the handling of drill-steel in use at large mines are the following. Wooden racks, either horizontal or vertical, are built on each level near the shaft, where sharp steel is kept always on hand arranged in the different racks according to lengths; then, whenever any miner wants sharp steel he merely carries out his dull drills to the shaft-station and takes back sharp sets; the racks are kept full and the dull steel is taken to surface by a special man or two. To convey the steel between the shaft and the sharpening-shop, horses and wagons can be employed advantageously; one mine has a special wagon-box which is removed at the shop by a traveling-crane and lifted handily to the drill-sharpeners. Another aid to good work by the miners is to keep each contract's or gang's steel separate. Numbers corresponding with the contract are stamped on the shank of each drill, and when sharpened each contract's drills are packed neatly in a 5-inch iron ring and held there securely with wooden wedges. Miners work to better advantage when they have individual steels.

The practice of constructing a tunnel from just below the collar of the shaft to the sharpening-shop is to be commended. Such tunnels have a narrow-gauge track and push-car, and are lighted by electricity. By the use of them, drill-steel can be unloaded from the cage onto the push-car without disturbing operations around the surface of the shaft, which is always a busy place.

Recent improvements in mechanical drill-sharpeners and drill-makers, and the use of special dies for forming new-style bits, such as the Carr, have tended to systematize and improve the sharpening of drill-steel. The assiduous application of the principles of scientific management has indicated the immense importance of properly-designed and correctly-sharpened bits. Drill-steel and bits are seemingly trivial but actually are extremely significant matters. It is the drill-bit that is the critical link between the men and the rock to be removed.

The Copper in Michigan Ores

Sorting of the ore before hoisting is usual in the copper mines of Lake Superior. Just how much sorting to do is a nice point at this time of high prices for copper when the manager is given the choice either of hurrying out a lot of rich ore for the greater profit in its higher content of copper or of utilizing lower-grade ore that could not be mined in ordinary times. The *Houghton Mining Gazette* gives the present estimated amount of copper in pounds recovered by the Michigan mines per ton of ore treated as follows:

	Lb. copper per ton.		Lb. copper per ton.
Tamarack	19	South Lake	24
Osceola (old)	13	Arcadian	30–34
North Kearsarge	14	Isle Royale	15–15½
South Kearsarge	18	C. & H. (conglomerate)	23–25
Ahmeek	24	C. & H. (amygdaloid)	15–25*
Wolverine	20	Baltic	30–35
Mohawk	19	Champion	35–50
Franklin	20–21	Trimountain	24–26
Centennial	16½	Winona	18
Allouez	18	Victoria	14–16
Mass (including mass copper)	16–18	White Pine	35
Superior	18	Houghton Copper	28
Hancock	18–19	Lake	25
La Salle	12–13	Quincy	20–21

*Average perhaps 17.

It is to be noted that the mines of the Copper Range Consolidated show a high recovery, which is due partly to a good grade of ore and partly to unusually careful selection underground. The Quincy mine, which has been operated for more than 60 years, shows little variation in its grade of ore. The Franklin mine probably will increase its recovery, as more of the richer conglomerate ore is hoisted and less of the amygdaloid; this mine has bettered the grade of its ore gradually during recent years. Isle Royale has raised its recovery from 13 lb. a few months ago to 15 lb. at this time. The White Pine Extension, which has been diamond-drilling, and experimenting on the treatment of its ore, is planning its equipment, shaft-sinking, and buildings.

Chrysotile-Asbestos

By F. H. MASON

Playing the rôle of showman in the mineral section of a foreign pavilion at an international exposition brings forcefully to one's mind two things: what one does not know, or has forgotten, about minerals and what the other fellow does not know. The first, with a little diligence, can be remedied, but the polite answering of inane questions, day after day, is calculated either to send one irretrievably to perdition or fit one for the diplomatic service.

The asbestos exhibit in the Canadian pavilion seems to have appealed more than any other to the public fancy, and probably has been the source of more questions than all the other exhibits together. A number of people have taken objection to the classification, and if reminded that minium was at one time the name for red oxide of mercury, which, in times gone by, was so adulterated with peroxide of lead that the adulterant took the name of the article it was infringing, and that the same thing is taking place with asbestos and chrysotile, with the difference, however, that chrysotile is for most purposes the superior and far more expensive mineral, they are often inclined to sneer and pass on to the next case. Then there are not a few who have asked whether asbestos is a mineral or vegetable, and between these extremes have been a number of questions, some humorous, some perfectly intelligent, but the majority of which go to show that the public has many wrong notions about the mineral, the chief of which is that asbestos is the most fire-resistant substance known to science. It would seem, then, that, though I do not pretend to offer anything new on the subject, a short account of the mineral will not be without interest.

It is well, at once, to admit that mineralogically, chrysotile is not a true asbestos, but commercially, owing to the fineness, flexibility, and tensile strength of its fibre, it has almost entirely replaced asbestos proper for many purposes, and has a market-value twenty to sixty times greater than the latter mineral. Thus the man on the street, who, after all, plays no small part as an arbiter in the matter of language (I am prepared for squalls, Mr. Editor) has dropped the word 'chrysotile' and adopted 'asbestos' instead. Who, for instance, ever saw the curtain in front of the stage at a theatre labeled 'Fire-proof chrysotile curtain'? yet probably 90% of the so-called asbestos curtains are made of chrysotile.

The term 'asbestos' was originally applied to highly fibrous varieties of hornblende having a formula $RSiO_3$, in which R represents magnesia and lime, which, however, may be replaced by ferric or ferrous oxide, or alumina, and sometimes two or all of those oxides. Chrysotile, on the other hand, is a fibrous variety of serpentine having a formula $H_4Mg_3Si_2O_9$, a small part of the magnesia being sometimes replaced by ferric oxide and more rarely by ferrous oxide or alumina. It will be seen, then, that both varieties are silicates of the alkaline earths, chrysotile being more base than the hornblende variety, and, unlike the latter, contains some 13% of combined water. But it is in the physical, rather than the chemical, properties that the great difference between chrysotile and hornblende asbestos is found. The fibre of chrysotile possesses a far greater tensile strength and flexibility and can be separated into infinitely finer threads, and, for these reasons, is much better suited for weaving purposes. Chrysotile loses water at a dull-red heat, and, at the same time, loses much of its flexibility, then behaves more like the hornblende varieties; between 1200 and 1300°C. it sinters and breaks up into olivine and enstatite, and at 1700°C. it fuses. It will be seen, then, that while chrysotile resists heat to a marked degree, and, in the case of a fire-proof curtain, would confine effectively the fire to the side of the curtain on which it occurred—though it would lose its flexibility in the effort if the fire were a big one—it is by no means the most refractory substance known, and would be entirely unfitted to resist the prolonged attack of high temperatures, such as are to be found in many metallurgical operations. It is, perhaps, as a non-conductor of heat that chrysotile shows to the greatest advantage. The loose or woven fibre is crowded with myriads of minute air-cells, and, the fibre being incombustible, it forms an incomparable heat-insulator. Combined with magnesia and magnesium chloride or portland cement, it is used, and being used more and more, as a fire-proof material for the roofs and sides of buildings. Chrysotile rope, mixed with graphite for lubricating purposes, forms an excellent packing for stuffing-boxes that are heated by high-pressure hot water, steam, and hot air to such a degree as to put organic packing-materials out of the running. These are only a few of the many uses to which asbestos can be put advantageously.

Today, Canada is providing about 85% of the asbestos production of the world; all of this is chrysotile, and is obtained from the great serpentine belt in the eastern townships of the province of Quebec. Owing to the overburden in this neighborhood, much of which is heavily wooded, the limits of the belt have not been determined, but it is known to be over 6 miles long and 1¼ miles across in the widest part. The belt is crossed in all directions by granite intrusions that seem to have played a part in fissuring the serpentine, for it is generally near these intrusions that the most productive ground is found. Fritz Cirkel, from whose excellent work* I have borrowed extensively, has estimated the known produc-

*'Chrysotile-Asbestos: Its Occurrence, Exploitation, and Uses.'

tive area to be 11,320 acres, of which about only one-tenth is under active development. In the productive areas the fissures, whether caused by granite intrusions or by other means, cross the belt in all directions; they have been filled by chrysotile fibre, undoubtedly formed from the surrounding rock, which is of almost identical chemical composition. Except in slickensides, where the fibre lies parallel with the planes of movement, and is known as 'slip-fibre,' it always occurs at right angles to the dip of the veins. The 'slip-fibre,' besides chrysotile, often contains picrolite, which, on account of its inferior physical qualities, is separated as much as possible from the material that goes to the mill.

By far the greater quantity of chrysotile produced is won by quarrying in open pits, that rarely exceed a depth of over 250 ft., through chrysotile has been proved at depths of over 400 ft. The whole of the productive rock is removed, the long-fibre asbestos separated by hand-cobbing, and the rest of the material sent to the mill. Statistics over the last two years show that the fibre recovered forms only 6% of the material milled; the figures for 1913 being 2,110,990 tons milled and 127,539 tons of fibre produced.

A Trip Through Eastern Canada

By P. B. McDONALD

In spite of the War, the production of asbestos in the eastern townships of Quebec is larger than for several years. This district, from which comes the greater part of the world's supply of asbestos, had been depressed for a long time, and matters looked still worse when Germany's large consumption suddenly ceased. But the demand began to improve last winter, during which season, as a rule, the open-cut asbestos mines are closed, by reason of difficulties arising from snow and water. Companies that practically stopped work in the early days of the War have resumed operations and have been steadily increasing their production. The renewal of profit is due partly to the improved general outlook in the United States and Canada, and perhaps to the efforts being made by both British and American manufacturers to capture German trade in South America and other markets where asbestos products are in demand. Another consideration is that Russian export of asbestos has been hindered by the blocking of trade-routes, so

EXHIBIT OF ASBESTOS IN THE CANADIAN PAVILION OF THE PANAMA-PACIFIC EXPOSITION.

that competition is lessened. Incidentally the possibility of producing asbestos in Arizona is receiving attention.

Traveling on the Quebec Central railway, which runs between Sherbrooks and the city of Quebec, it is easy to tell when the asbestos country is reached, as a thick gray dust fills the air, covering the bushes and everything in sight. It is the result of the dry processes of concentration used in the big barn-like mills that are scattered among the pits. One is reminded of an oilfield by the many towers and tripods rising on the edges of the pits, where they serve for cable-hoisting systems, since they resemble derricks in the manner in which they dot the landscape. A visiting mining man is surprised to see this system of hoisting by a network of cables strung across the pits, usually radiating from one tower near the hoist-house, and each held at the other end, across the pit, by a separate fastening, near which is a little house where a boy signals by electric-button to the hoisting engineer. Thus a single pit, not so large as a Lake Superior iron-ore pit, but probably deeper, will have half a dozen cables strung across it, run by half-a-dozen hoisting-engines, each with an engineer and a signal-boy. It appears at first as though the hoisting could be concentrated, so that two or three hoists at a pit could be eliminated, and a Michigan iron-miner would ask why a single inclined track with a good-sized skip handled rapidly could not replace the half-dozen cable systems with their one-ton 'boxes.' A loaded box is raised vertically from the pit to the horizontal cable, then run to the dumping-station in the cable-tower. Once or twice Cornish mine-bosses have tried to concentrate the hoisting, but without success, because tram-cars and tracks are a bother in these narrow pits, by reason of irregularities caused by caving walls, and the blasting and sorting systems in vogue. The asbestos is found in jointed irregular ground with weak walls, so that drill-holes pointed in the 'toe' of a mass of rock and blasted will break a huge amount into the pit. Thus it is advantageous to have in the pit as little paraphernalia as possible.

The pit of the B. & A. Asbestos Co., at Robertsonville, one of the biggest asbestos mines in the world, has been hoisting nearly 1000 tons per double-shift. Thus with five hoists, raising one ton at a time, each hoisting-engine has a hundred loads to handle in ten hours. The asbestos-rock is taken in cars by gravity, to the mill, where it is crushed, concentrated, and packed. After preliminary crushing in a jaw-crusher, the material is dried. Since the concentrating is accomplished by dry or air methods, it is necessary that the crushed rock should be dry and dusty, so that the 'fibre' can be separated from the rock particles, to which they would adhere if damp. The drying is done in long, revolving, inclined cylinders, each containing five smaller cylinders or tubes, while a wood-fire underneath furnishes the heat. Each tube is a foot in diameter and serves to separate the material into lesser streams more readily affected by the heat. Wood is burned as fuel because of the longer flame and because the heat from coal is too intense. The use of coal is exceptional. After drying, the material goes through small jaw-crushers, is sized on shaking-screens, crushed again in mills that reduce the particles with revolving iron beaters, and is then screened and re-screened to separate the fibre from the tailing. On the shaking-screens, inclined at a small angle, a suction like that of a 'vacuum-cleaner' across the lower portion lifts the fibre, leaving the fragments of rock to go over the end. To separate the dust from the fibre, several large galvanized-iron revolving cones are employed, arranged with their tops opening through the roof of the mill, so that the dust may blow away. The product, which resembles matted silk or cotton fluff, is graded according to the length of the fibre at the different bins and packed into burlap bags for shipment. The longer the fibre, the higher the market-value; fibre two inches long and unusually silky (generally picked from the ore before going to the mill) brings several hundred dollars per ton, though there is not much of this. Such long fibre can be spun into asbestos cloth and special articles. One or two localities, notably around Thetford, produce most of the long fibre. The market-prices paid for asbestos vary from $10 to $275 per ton, different grades bringing $30, $50, or $100 per ton.

The proportion of fibre to the rock hoisted varies from 5 to 10%; in exceptional cases it is as high as 13 or 14%; usually a mine hoisting 1000 tons of rock per day will produce less than 100 tons of asbestos, perhaps 60 or 70 tons. Each mine accumulates an enormous waste-dump of fine crushed rock or tailing, built high by conveying the tailing up a long incline. These great waste-heaps are a striking feature of the district; added to the towers, cables, and the dusty atmosphere, they make a scene of industrialism that impresses the visitor. The features that will linger in his mind are the concentrating without water, the multiplicity of hoisting-cables, the texture and nature of the asbestos-rock, and the excellent labor available.

Asbestos is found over a large territory in Quebec. The fibre is mixed in a medium-hard gray rock, through which it is interspersed as stringers or veinlets; the rock lies nearly vertical, and the merchantable deposits may be several hundred feet wide. The fibre is locally called 'cotton.'

The labor-supply is excellent. The men are capable, sinewy, and not afraid of a day's work. The asbestos mines are in the heart of French Canada, where the contented and sturdy 'Canuck' is at home. It is not necessary to furnish these miners with 'welfare' advantages to keep them interested; they are full of the *joie de vivre* and of vigor, as is indicated by their large families. No happier people is to be found on the North American continent. Incidentally it is a striking example of British liberty to find the French schools in Quebec using French text-books instead of English, and the French communities are allowed all possible privileges in managing their own affairs. I enjoyed much pea-soup on my trip; and in asking my way along various roads was struck by the universal courtesy of *le habitant* and his bright-eyed progeny, who were always glad to supplement a limited knowledge of the American language by going out of the way to do a service. It is

interesting to see, so few hours from Boston or New York, an extensive country where 'Safety First' is spelled '*Sureté d'abord,*' the Post-Office is labelled '*Bureau de Poste,*' and where everyone from seven to seventy wishes you "*Bon jour, monsieur!*"

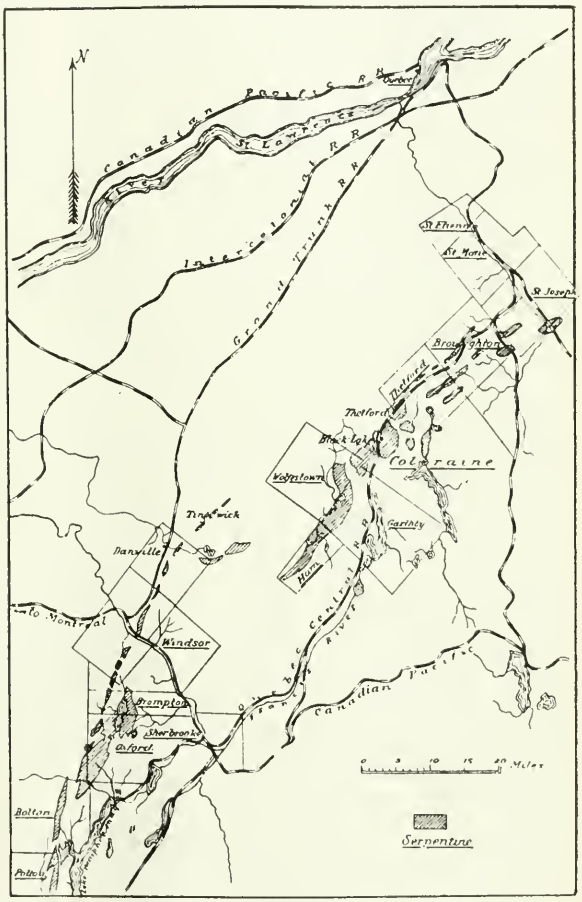
The asbestos industry has the reputation of being a business of small profits, owing to the competition of a number of companies. But this Canadian district is by far the most important in the world, and just now, at least, is doing well.

A few miles to the south of the asbestos country, near Weedon, is a profitable copper mine, the McDonald, named from the prospector who was responsible for its exploration, and who reaped a well-deserved reward in a financial way. Although only a small mine, as copper mines go, this property is shipping steadily, and is surprising people by its success. Sixty men are employed and close to 200 tons of ore daily is sent over an aerial cable-way to Weedon station, to be forwarded to smelters in 'the States.'

In Nova Scotia, the coal-mining industry was a little slack in 1914 and the customary 7,000,000 tons was not attained by over half a million. More optimism is apparent at present, because of opportunities for selling Nova Scotia coal in ports where Welsh and Scotch coal is not now available on account of Britain's extraordinary demand for war purposes. Nova Scotia's coal mines are especially valuable because most of them are situated on Cape Breton island, within a few miles of ocean-ports at Sydney and Louisburg. Twelve thousand men are employed in these mines, which are controlled by two or three large corporations; a number of slopes and shafts are in operation on several seams. The shipments to the United States, never very large, fell to considerably below the customary half-million tons in 1914. The iron and steel industry at Sydney, represented by the Dominion Iron & Steel Co., and the Nova Scotia Steel & Coal Co., with furnaces on tide-water, also was slack in 1914. Excellent iron ore is obtained from Bell island off the east coast of Newfoundland, being brought in steamers over the 400 miles of water. The two big iron-ore mines on Bell island, extending several miles under the ocean, have been gradually expanding operations since the dull times of the last autumn. The profitable German trade with the Krupps ended with the War, but the English demand has been growing.

Not so much is heard recently of the big new development planned for the sparsely-settled west coast of Newfoundland. A company with a capital of $8,000,000 promoted by 'Carbide' Wilson, has done extensive surveying and designing for water-power development, mining, milling, etc., at Bay of Islands; and negotiations with the Government have been in progress for privileges as to water-power, phosphate lands, sites, etc. The Reid family, of St. Johns, which built and operates the Newfoundland railway, is reported to be financially interested, together with Canadian capitalists. It is said that two thousand men will be employed. If successful, this will be the first large industry for Newfoundland's neglected west coast, the old 'French shore' of fishery disputes.

The difference between Canada's banking system and



SERPENTINE AREAS IN THE EASTERN PART OF QUEBEC.

that of the United States is apparent particularly in the method of assisting new business. A Canadian business-man of good reputation, who needs funds for carrying out his projects, will go to a bank and make a complete statement of his plans. The bank investigates his affairs thoroughly, and furnishes the capital necessary. Thus the banks uphold industries to an extent unheard of in the United States, and enter into a man's personal plans to such a degree that they are virtually partners in the several diverse businesses that usually grow up as their client's interests multiply.

Cyanide Treatment of Flotation Concentrate

By CHARLES BUTTERS and J. E. CLENNELL

When Charles Butters began to take up the work of flotation in our Oakland laboratory, one of the first points brought to our attention was the treatment of the concentrate produced by flotation; J. E. Clennell was accordingly instructed to undertake the researches detailed in the present paper.

The whole value of the process hinges on two points, namely, the grade of tailing produced and the net realization of the value contained in the concentrate, these two considerations being of equal importance. This last point is complicated by questions of geographical situation, for if the concentrate cannot be treated locally the cost of realization may be so heavy that flotation would be entirely precluded.

The results obtained in our laboratory by the combination of flotation and cyanide have been so remarkable that a serious study of the disposal of concentrates has been forced upon us.

The difficulties attending the treatment of concentrate by cyanide are well known. The process of concentration collects in a small bulk not only the valuable constituents of the ore but also those substances that act as cyanicides, or which are readily converted by oxidation or otherwise into cyanicides, so that their influence, per ton of material treated, is greater than would be the case with the unconcentrated ore. Heavy minerals such as the sulphides of iron, copper, lead, arsenic, antimony, zinc, and double sulphides such as mispickel, proustite, pyrargyrite, and bornite, naturally tend to accumulate in the concentrate. If some interval elapses between the formation of this concentrate and its treatment, oxidation may take place, with formation of sulphates, arseniates, and antimoniates, which are still more detrimental to cyanide treatment than the original minerals. These difficulties have been wholly or partly overcome by the adoption of modifications in the treatment, such as preliminary water, acid, or alkali washing, roasting, fine grinding, the use of special solvents, such as bromo-cyanide, and prolonged contact of the material with cyanide, extending in some cases to over a month.

In the case of concentrate produced by flotation, the minerals composing the product are substantially the same as those obtained by gravity concentration, consisting of the sulphides and double sulphides of the heavy metals, and it is to be expected that the same difficulties will be encountered in their treatment. But as the concentrate also contains a considerable part of the oil, tar, or other flotation agent, the presence of this foreign matter must be taken into account. In some cases, this circumstance introduces an additional difficulty. A part of this organic matter is soluble in the cyanide or alkali used in the process, and the solution so formed may be capable of absorbing oxygen. The effect produced by carbonaceous matter in precipitating gold and silver previously dissolved by cyanide is well known and has been a source of much trouble in many localities. Some of the constituents of this matter are not easily eliminated and appear to resist oxidation even at a high temperature; roasting under ordinary conditions does not completely remove the carbon; it is probable that a portion derived from tar remains in the graphitic form, capable of acting as a precipitant for gold or silver.

The experiments detailed below were made on concentrates produced from typical gold and silver ores by a modified type of the Minerals Separation flotation machine. Most of the tests were made in neutral or alkaline media. The frothing agents employed were those in general use, consisting of tar, creosote, carbolic acid, pine-oil, and fuel-oil. It is not proposed to discuss these in detail in the present paper; it will be sufficient to state that the concentrate was collected and drained on a vacuum-filter and in some cases dried at a moderate temperature before cyanide treatment.

As an example of an ore in which the value consists essentially of gold we may take the product of the San Sebastian mine, in Salvador, operated by the Butters Salvador Mines, Ltd. For preliminary work a composite sample was made from 21 lots taken from different parts of the mine, and concentrate produced by treating the finely crushed ore in a 10-lb. flotation machine. The sample taken for this test assayed originally 1.54 oz. gold and 0.28 oz. silver. The concentrate obtained by flotation assayed 4.92 oz. gold and 1.14 oz. silver. As this constituted 25% of the weight of ore taken, the gold recovered in the concentrate amounted to 79.9% of the total. An analysis of the concentrate showed:

	%		%
Insoluble	44.3	Iron	24.3
Sulphur	26.2	Copper	0.8

together with small quantities of molybdenum, tellurium, and other elements. The tailing carried 0.04 oz. gold per ton.

The first tests were made with the object of determining whether this material could be treated advantageously raw by agitation with cyanide. In addition to direct cyanide treatment various modifications were tried, as shown in Table I, including addition of lead acetate, preliminary alkali treatment, desulphurizing with alkali and aluminum, and bromo-cyanide. The last procedure showed a marked improvement over every other method of raw treatment, but still failed to yield a satisfactory extraction. The extraction was increased by increasing cyanide strength, but with strong solution the consumption of cyanide became prohibitive, and alka-

line sulphides were formed. This effect can be prevented and cyanide consumption much reduced by addition of lead acetate, some improvement in extraction being obtained. Preliminary alkali treatment with or without aluminum showed no benefit whatever. The fact that bromo-cyanide has a marked effect on the extraction suggests that a portion of the gold may be present as a telluride. This conclusion is supported by experiments made by direct treatment of the original ore, without concentration; these tests showed that a certain proportion of the gold is inaccessible to cyanide even after very fine grinding and prolonged contact. (See Table XI on page —.)

concentrate was cyanided raw before roasting and acid-washing, and re-cyanided after the washing; this also showed no advantage either in extraction or cyanide consumption over direct roasting, water-wash, and cyanide. In all cases the roasted material was agitated with cyanide, using a dilution of 3:1. The results obtained by these three methods are shown in the following table. (No. II.)

In Test No. 2 the acid-washing was made with 1% H_2SO_4, using approximately 5 tons of wash per ton of concentrate treated. Before agitation with cyanide, the pulp was re-ground in a model tube-mill with glass marbles.

TABLE I

Summary of Results in Treatment of Raw Concentrate

	Gold, Oz.	Silver, Oz.
Head assay for all tests.....	4.92	1.14

Dilution in all tests, 3:1.

Test No.	Method.	Time, days.	Cyanide strength KCN, %	Chemicals consumed per ton. Cyanide, Lb.	Lead acetate, Lb.	BrCN, Lb.	Residue assay. Gold, Oz.	Residue assay. Silver, Oz.	Extraction. Gold, %	Extraction. Silver, %
1.	Direct cyanide	3	0.25	32.7	..	..	4.38	1.06	11.0	7.0
2.	" "	3	0.5	39.1	..	..	3.88	0.88	21.1	22.8
3.	" "	3	1.0	52.3	..	..	3.46	0.70	29.7	38.6
4.	With lead acetate.....	3	0.25	19.5	10	..	3.02	0.74	38.4	35.1
5.	Preliminary NaOH	5	0.25	35.9	..	..	3.76	1.00	23.6	12.3
6.	Preliminary NaOH + Al	5	0.25	35.9	..	..	3.68	1.00	25.2	12.3
7.	Bromo-cyanide	8	0.25	41.1	..	8.3	1.20	0.68	75.6	40.4
8.	Similar to No. 7, but without bromo-cyanide	8	0.25	35.5	..	..	3.50	0.86	28.9	33.3

As these results did not appear encouraging for any system of raw treatment, attention was next turned to roasting. It was soon found that roasting within certain limits of temperature converted a considerable part of the copper into sulphate, which could be leached with water, together with some sulphate of iron, leaving the residue in a favorable condition for cyanide treatment. Preliminary acid wash of the roasted material was also tried; this would have the advantage of dissolving a further quantity of copper that might have become converted into oxide in the roasting, but the results show that the benefit obtained would not warrant the additional cost. Another test was made in which the concentrate was cyanided raw before roasting and acid-washing, and re-cyanided after the washing; this also showed no advantage either in extraction or cyanide consumption over direct roasting, water-wash, and cyanide. In all cases the roasted material was agitated with cyanide, using a dilution of 3:1. The results obtained by these three methods are shown in the following table. (No. II.)

In Test No. 3 the preliminary raw treatment was made with 0.1% KCN using a dilution of 2:1, for two days; the extraction of gold was 12%. Acid treatment was made with 1% H_2SO_4, dilution 1:1, agitated 18 hours and then leached with water before cyaniding. Roasted and washed concentrate agitated with cyanide for 4 days.

Test No. 1 on Table II indicates that the flotation concentrate from the San Sebastian ore may be successfully treated by a simple process of roasting, water-washing, and cyaniding. This conclusion was confirmed by numerous experiments on a larger scale in which the material was roasted in a hand-reverberatory furnace, and the

TABLE II

Comparative Results of Cyaniding After Roast with Various Preliminary Treatments

Test No.	Time under cyanide. Days.	Strength used KCN. %	Cyanide consumed per ton of raw concentrate. Lb.	Weight of 1 ton raw concentrate after treatment. Ton.	Assay of raw concentrate. Gold, oz.	Assay of raw concentrate. Silver, oz.	Assay of roasted and washed concentrate. Gold, oz.	Assay of roasted and washed concentrate. Silver, oz.	Residue of treated material. Gold, oz.	Residue of treated material. Silver, oz.	Calculated residue on raw concentrate. Gold, oz.	Calculated residue on raw concentrate. Silver, oz.	Recovery* based on raw concentrate. Gold, %	Recovery* based on raw concentrate. Silver, %
1	3	0.25	4.20	0.792	4.92	1.14	6.20	1.44	0.15	1.37	0.12	1.09	97.5	4.9
2	3	0.25	6.49	0.790	4.92	1.14	6.28	1.36	0.125	1.20	0.10	0.95	98.8	11.1
3	6	0.10	8.93	0.773	4.92	1.14	5.44	1.44	2.00	1.28	1.55	0.99	64.9	10.9

*See note, page ??.

Test No. 1. Oxidizing roast, water-wash, and cyanide.

Test No. 2. Oxidizing roast, acid-wash, and cyanide.

Test No. 3. Cyaniding raw, roasting, acid-wash, and re-cyaniding.

roasted product treated by agitation in tanks with mechanical stirrers, adding water, settling, and decanting until the bulk of the copper and iron salts was removed, finally collecting the material on a vacuum-filter and washing on the filter to remove the last traces of soluble salts. The washed concentrate was then repulped with lime and cyanide solution in an agitation-tank, and treatment continued in the ordinary way. The results of the bottle tests were fully confirmed.

Attempts to treat the material by percolation were not successful. Owing to the fine grinding of the ore previous to flotation, the roasted material showed a tendency to slime; percolation took place slowly and irregularly, through channels formed in the mass, so that the extraction by this means was always imperfect.

In the tests made in the large muffle the oxidation was somewhat more effective, but a rather longer time was required to reach the temperature at which roasting began. Temperature was approximately determined by Seger cones.

On examing the details of Table III, it will be apparent that the most favorable results were obtained when roasting was carried out at a low temperature; under these conditions a maximum amount of copper was extracted by water-washing, and the highest extraction of gold obtained with a minimum cyanide consumption.

TABLE III

BOTTLE-AGITATION TESTS ON CONCENTRATE ROASTED AT DIFFERENT TEMPERATURES

In each case 100 grams of concentrate was roasted in the muffle, and a test made of the roasted material, after water-washing. The charge for cyanide treatment was as follows:

Roasted and washed concentrate, 60 gm. Lime, 0.6 gm. Solution, 180 c.c. 0.5% KCN. Agitated at intervals for 3 or 4 days and solution strength maintained at 0.5% KCN.

	Gold, Oz.	Silver, Oz.
Assay of raw concentrate in each case.....	3.50	0.89

Test No.	Muffle used.	Temp. of roast, Deg. C.	Time of roast, Min.	Weight of 1 ton: After roast, Ton.	Weight of 1 ton: After wash, Ton.	Copper extracted per cent of raw concentrate: By water, %	By cyanide, %	Total, %	Cyanide consumed: Per ton of washed Conc., Lb.	Per ton of raw Conc., Lb.
1.	Small	590	55	0.811?	0.785?	0.244	0.083	0.327	6.5	5.1
2.	Large	590	65	0.849	0.825	0.242	0.145	0.387	9.2	7.6
3.	Small	620	60	0.848	0.830	0.207	0.165	0.372	8.9	7.4
4.	Large	620	80	0.849	0.840	0.040	0.185	0.225	12.0	10.1
5.	Small	650	65	0.853	0.832	0.189	0.096	0.285	9.0	7.5
6.	Large	650	75	0.848	0.839	0.061	0.128	0.189	10.0	8.4
7.	Small ...under	590	87	0.867	0.836	0.287	0.078	0.365	6.6	5.5
8.	Large ... "	590	70	0.877	0.854	0.406	0.063	0.469	4.4	3.8
9.	Large ... "	590	60	0.878	0.839	0.428	0.052	0.480	6.4	5.4

	Head assays. Roasted concentrate.		Roasted and washed concentrate.		Roasted and washed concentrate, calc. on raw.		Residue assays after cyanide. Roasted and washed concentrate.		Calculated on raw concentrate.	
Test No.	Gold, Oz.	Silver Oz.	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.
1	3.90	0.99	4.02	1.02	3.16	0.80	0.13	0.77	0.10	0.60
2	3.89	0.90	4.00	0.94	3.30	0.76	0.06	0.72	0.05	0.59
3	3.95	0.98	4.04	1.00	3.35	0.83	0.07	0.79	0.06	0.66
4	4.05	1.01	4.10	1.02	3.44	0.86	0.09	0.86	0.08	0.72
5	4.06	1.03	4.16	1.06	3.46	0.88	0.08	0.82	0.07	0.68
6	3.96	1.01	4.00	1.02	3.36	0.86	0.07	0.82	0.06	0.69
7	3.91	0.95	4.06	0.98	3.39	0.82	0.06	0.72	0.05	0.60
8	3.97	1.04	4.08	1.06	3.48	0.91	0.055	0.64	0.05	0.55
9	3.97	0.88	4.16	0.92	3.49	0.77	0.08	0.58	0.07	0.49

Test No.	Lost in roasting and washing. Per ton of raw conc. Gold, Oz.	Silver, Oz.	Days under cyanide.	Extraction: On roasted and washed concentrate. Gold, %	Silver, %	Calc. on raw concentrate. Gold, %	Silver, %	Recovery: Calc. on raw concentrate. Gold, %	Silver, %
1	0.34	0.09	4	96.8	24.5	97.1	32.6	87.4	22.5
2	0.20	0.13	4	98.5	23.4	98.6	22.5	92.9	19.1
3	0.15	0.06	4	98.2	21.0	98.3	25.8	94.0	19.1
4	0.06	0.03	4	97.8	15.7	97.7	19.1	96.0	15.7
5	0.04	0.01	3	98.1	22.6	98.0	23.6	96.9	22.5
6	0.14	0.03	3	98.2	19.6	98.3	22.5	94.3	19.1
7	0.11	0.07	3	98.5	26.5	98.6	32.6	95.4	24.7
8	0.02	...	3	98.7	39.6	98.6	38.2	98.0	40.4
9	0.01	0.12	3	98.1	37.0	98.0	44.9	97.7	31.5

In this ore the silver is negligible, but it is significant that the silver extraction on the roasted material is poor in all cases. This condition will be noted in most cases where attempts have been made to treat silver ores by cyanide after an oxidizing roast.

With these results as a guide, tests were made on a larger scale on the same material, roasted by hand in an oil-fired reverberatory furnace. A charge of about 400 lb. was dried slowly in a sample drier, and charged into the furnace; the temperature was gradually raised till it approximated that obtained in the muffle-roasts, probably about 550° C. After 3½ hours, the flame was turned off and the charge allowed to cool in the furnace overnight. The concentrate roasted in this way, showed little or no tendency to sinter or form lumps, but in subsequent tests when the material was charged without previous drying, portions of the concentrate agglomerated into comparatively hard lumps, which contained a core of unroasted material, and which it was necessary to sift out and re-roast after grinding. Possibly in practice it would be advisable to pass the material, after drying and before roasting, through a ball-mill or similar pulverizer.

A bottle-test made on a scale of 100 gm. on a sample of roasted concentrate from the above reverberatory charge showed the following results:

TABLE IV

Copper extracted per cent of raw concentrate:	
By water-wash	0.435
By cyanide	0.039
Total	0.474
Cyanide consumed per ton of washed concentrate	5.03 lb.
Cyanide consumed per ton of raw concentrate	4.21 lb.
Under cyanide treatment	3 days

1 ton raw concentrate = 0.837 ton washed.

	Gold, Oz.	Silver, Oz.
Assay of roasted concentrate	3.70	0.86
Assay of washed concentrate	3.90	0.94
Assay of washed concentrate calculated on raw concentrate	3.26	0.79
Loss per ton of raw concentrate	0.24	0.10
Residue assay on washed concentrate	0.05	0.60
Residue assay calculated on raw concentrate	0.04	0.50
	%	%
Extraction on roasted and washed concentrate	98.7	36.2
Extraction calculated on raw concentrate	98.9	43.8
Recovery calculated on raw concentrate	92.0	32.6

The loss shown in this test seems to be mostly mechanical, due to dust carried off while stirring the charge; it could probably be much reduced by using a suitable roaster with revolving rabbles and a dust-chamber.

Agitation Tests

The following tests were made in small tanks fitted with wooden paddles.

No. 1. Agitated with cold water, washed by settlement and decantation, then drained by vacuum on a horizontal filter-tray; re-pulped with lime and cyanide solution.

No. 2. Agitated with hot water, washed by settlement and decantation, neutralized with lime and agitated with cyanide without previous filtration. Cyanide treatment by decantation, finally washing with water.

TABLE V

Tests Made by Agitation and Decantation

	No. 1.	No. 2.
Weight of roasted concentrate taken	100 lb.	50 lb.
1 ton raw concentrate = after roast (ton)	0.876	0.876
1 ton raw concentrate = after wash	0.837	0.837
Dilution of pulp in water-washing	3:1	3:1
Total preliminary water-wash used per ton (tons)	2.37*	10.7
Copper extracted per ton of roasted concentrate	?	8.04 lb.
Lime added per ton	30 lb.	30 lb.
Cyanide strength used (KCN)	0.25%	0.25%
Cyanide consumed per ton of roasted concentrate	2.36 lb.	4.58 lb.
Cyanide consumed per ton of raw concentrate	2.06 lb.	3.83 lb.
Dilution of pulp in cyanide treatment	3:1	3:1
Time of cyanide treatment (days)	3	5
Total solution used per ton of ore (tons)	4	3.8

*Additional wash given on filter.

	Test No. 1. Gold, Oz.	Test No. 1. Silver, Oz.	Test No. 2. Gold, Oz.	Test No. 2. Silver, Oz.
Assay of raw concentrate	3.50	0.89	3.50	0.89
Assay of roasted concentrate	3.70	0.86	3.70	0.86
Assay of roasted and washed concentrate	3.90	0.94	3.90	0.94
Roasted and washed, calculated on raw concentrate	3.26	0.79	3.26	0.79
Residue of roasted and washed concentrate:				
(*a*) After cyanide	0.11	0.55	0.08	0.56
(*b*) Calculated on raw concentrate	0.09	0.46	0.07	0.47
Residue sample with extra wash in laboratory:				
(*a*) On roasted concentrate	0.06	0.54	0.04	0.53
(*b*) Calculated on raw concentrate	0.05	0.44	0.03	0.44
Extraction by cyanide.	%	%	%	%
Calculated on residue as discharged (*a*)	97.2	41.5	97.9	40.4
Calculated on residue as discharged (*b*)	97.4	48.3	98.0	47.2
With extra wash (*a*)	98.5	43.6	99.0	43.6
With extra wash (*b*)	98.6	50.6	99.1	50.6
†Recovery based on raw concentrate	90.6	37.1	91.1	36.0
Recovery with extra wash	90.7	39.3	92.3	39.3

†In calculating 'recovery,' allowance is made for losses of gold and silver in roasting.

Percolation Tests

Portions of the same roasted charge as were used for the previous tests were leached in tanks with a canvas filter, using vacuum to aid filtration. After washing out soluble salts as far as possible in this way, the residue was mixed with lime and treated by percolation with cyanide solution in the same manner.

The result of these tests indicates that thorough washing is essential for a high extraction. Filtration without vacuum was found to be practically impossible.

The following tests were made on another portion of roasted concentrate, to determine the influence of cyanide strength on extraction. Eight tests were made; in the first four a preliminary wash was given with hot salt solution, 10% NaCl using 2 tons of material treated. In the remaining four tests the preliminary wash was given with water alone, using 4 tons per ton of material. The salt wash showed some extraction of silver, but it does not appear that any advantage derived from this would warrant the additional cost.

The cyanide treatment is detailed below.

TABLE VI

Tests Made by Percolation

	No. 1.	No. 2.
Weight of roasted concentrate taken	100 lb.	32 lb.*
Total preliminary water-wash used per ton of roasted concentrate (tons)	3.84	3.92*
Lime added per ton (lb.)	30	26
Strength of solution used (KCN)	0.25%	0.25%
Cyanide consumed per ton of roasted concentrate (lb.)	6.48	2.77
Cyanide consumed per ton raw concentrate (lb.)	5.44	2.32
Solution used per ton of roasted concentrate (tons)	2.63	1.46
Final water-wash per ton of roasted concentrate (tons)	0.92	0.41
Time of cyanide treatment (days)	3	5
Depth of charge for percolation (inches)	2¼	10

*Hot water used, and ore charged into tank while hot (200°F.).

		Test No. 1. Gold, Oz.	Test No. 1. Silver, Oz.	Test No. 2. Gold, Oz.	Test No. 2. Silver, Oz.
(a) Residue of roasted and washed concentrate after KCN		0.65	0.70	3.00	0.77
(b) Residue calculated on raw concentrate		0.54	0.59	2.51	0.64
After extra wash in laboratory	(a)	0.22	0.62	2.18	0.78
	(b)	0.18	0.52	1.82	0.65
		%	%	%	%
(a) Extraction on roasted concentrate		83.3	25.5	23.1	18.1
(b) Extraction calculated on raw concentrate		84.6	33.7	28.3	28.1
After extra wash in laboratory	(a)	94.4	34.0	44.1	17.0
	(b)	94.9	41.6	48.0	28.0
*Recovery based on raw concentrate		77.7	22.5	21.4	16.9
Recovery after extra wash		88.0	30.3	41.1	15.7

*See note, page ??

In view of the unsatisfactory results obtained by percolation and the fact that further extraction was made by increased water-washing, the residue of charge No. 1 was mixed with the residue of charge No. 1 treated by agitation (see Table V) and the united charge agitated further with water, then with weak cyanide solution and finally with water again.

TABLE VII

Weight of united charge, 200 lb.

Extra washes:	Tons.
A. Water per ton of charge	1.9
B. Solution, 0.147% KCN, per ton of charge	0.4
C. Water per ton of charge	2.3
	4.6
Additional cyanide consumed per ton of charge in treatment B (lb.)	0.82
Total time for additional treatment	3 days

United Charges from Percolation and Agitation Tests, After Additional Washing

(1) After further water-washing A.
(2) Same with extra water-wash in laboratory.
(3) After final cyanide-wash B and water-wash C.
(4) Same with extra water-wash in laboratory.

	(1) Gold, Oz.	(1) Silver, Oz.	(2) Gold, Oz.	(2) Silver, Oz.	(3) Gold, Oz.	(3) Silver, Oz.	(4) Gold, Oz.	(4) Silver, Oz.
Residue on roasted concentrate	0.07	0.59	0.06	0.62	0.06	0.59	0.05	0.60
Residue calculated on raw concentrate	0.06	0.49	0.05	0.52	0.05	0.49	0.04	0.50
	%	%	%	%	%	%	%	%
Extraction on roasted concentrate	98.2	37.2	98.5	34.0	98.5	37.2	98.7	36.2
Extraction calculated on raw concentrate	98.3	44.9	98.6	41.6	98.6	44.9	98.9	43.8
Recovery calculated on raw concentrate	91.4	33.7	91.7	30.3	91.7	33.7	92.0	32.6

TABLE VIII

TESTS ON INFLUENCE OF CYANIDE STRENGTH

Charge for each test: roasted and washed, 100 gm.; lime, 1 gm. = 20 lb. per ton; solution, 300 c.c. = dilution 3:1.
Time under cyanide treatment..... 4 days
Weight of 1 ton raw concentrate after roast.....0.865 ton
Weight of 1 ton after roast and wash.....0.811 "

	Gold, Oz.	Silver, Oz.
Assay of raw concentrate.....	4.88	1.12
Assay of roasted concentrate.....	5.35	1.24
Assay of roasted and washed concentrate:		
1st series	5.72	0.82
2nd series	5.68	1.32
Assay of roasted and washed concentrate calculated on raw concentrate:		
1st series	4.68	0.67
2nd series	4.61	1.07

Test No.	Copper extraction per cent of raw concentrate. By water-wash, %	By cyanide, %	Total, %	Strength of cyanide used, KCN, %	Cyanide lb. consumed. Per ton of roasted and washed concentrate.	Per ton of raw concentrate.	Residue assays. On roasted and washed concentrate. Gold, Oz.	Silver, Oz.	Calculated on raw concentrate. Gold, Oz.	Silver, Oz.
Series No. 1:										
1	0.364	0.026	0.390	0.50	6.26	5.12	0.09	0.63	0.074	0.52
2	0.364	0.024	0.388	0.25	3.18	2.60	0.10	0.63	0.082	0.52
3	0.364	0.027	0.391	0.125	2.30	1.88	0.10	0.61	0.082	0.50
4	0.364	0.022	0.386	0.062	2.36	1.93	0.11	0.62	0.09	0.51
Series No. 2:										
5	0.411	0.034	0.445	0.50	6.20	5.03	0.08	0.66	0.065	0.54
6	0.411	0.036	0.447	0.25	4.42	3.58	0.08	0.68	0.065	0.55
7	0.411	0.040	0.451	0.125	3.19	2.59	0.095	0.71	0.077	0.58
8	0.411	0.038	0.449	0.062	3.44	2.79	0.10	0.72	0.08	0.58

Series No.	Test No.	Extraction on roasted and washed concentrate. Gold, %	Silver, %	Extraction calculated on raw concentrate. Gold, %	Silver, %	Recovery calculated on raw concentrate. Gold, %	Silver, %
1	1	98.4	23.2	98.5	53.4	94.4	13.4
	2	98.3	23.2	98.3	53.4	94.2	13.4
	3	98.3	25.6	98.3	55.4	94.2	15.2
	4	98.1	24.4	98.2	54.5	94.1	14.3
2	5	98.6	50.0	98.6	51.8	93.1	47.3
	6	98.6	48.5	98.6	50.9	93.1	46.4
	7	98.3	46.2	98.4	48.2	92.9	43.7
	8	98.2	45.5	98.4	48.2	92.8	43.7

From these results it appears that the extraction is scarcely affected by variation of cyanide strength within the limits and under the conditions of the tests. The cyanide consumption, however, increases with increasing strength. Apparently the best results are obtained with a strength of 0.125% KCN.

Two tests were also made on another portion of roasted concentrate from the same lot of ore to determine the influence of time on the cyanide treatment. The results are shown below.

From this test it is evident that the gold in the roasted concentrate is rapidly soluble in cyanide. The small insoluble portion seems to be quite inaccessible to prolonged treatment or to stronger solutions.

The foregoing tests sufficiently indicate that the San Sebastian concentrate, produced by flotation, may be treated successfully on a commercial basis by the method of roasting, water-washing, and cyaniding. Some tests were, however, made by alternative methods for the purpose of comparison.

TABLE IX

EFFECT OF VARYING TIME OF TREATMENT

Charge for test as in Tests Table VIII.
1 ton roasted concentrate = 0.919 ton after water-wash.

	Gold, Oz.	Silver, Oz.
Assay of roasted concentrate.....	4.05	2.45
Assay of roasted and washed.....	4.52	2.64
Calculated assay of roasted	4.15	2.43

Strength of solution maintained at 0.1% KCN.

	Test No. 1.	Test No. 2.
Time of cyanide treatment (hours).....	28	71
Cyanide consumed per ton treated (pounds)	1.50	3.70

	Test No. 1. Gold, Oz.	Silver, Oz.	Test No. 2. Gold, Oz.	Silver, Oz.
Residue of roasted and washed concentrate.....	0.095	1.73	0.09	1.61
Residue calculated on roasted concentrate	0.087	1.59	0.083	1.48
	%	%	%	%
Residue of roasted and washed concentrate.....	97.9	39.8	98.0	43.9
Extraction calculated on roasted concentrate	97.9	35.1	98.0	39.6

The processes thus tried were:

1. Chlorination by saturating the roasted charge with chlorine gas and leaching with water, as in the old Plattner process.

2. Direct cyanide treatment of the raw ore after fine grinding in a tube-mill with steel balls.

Chlorination Tests

A charge of roasted concentrate was moistened with about 15% of water, and placed loosely, without any paper or other filter, in a porcelain funnel with flat perforated diaphragm. Chlorine gas was introduced from below through the neck of the funnel, and after saturation, the charge was allowed to stand covered for 24 hours. It was then leached out with water and the residue dried and assayed. The extraction was found by difference of head and tail assays; it was also checked by precipitating the filtrate with ferrous sulphate, allowing to settle and collecting the deposited gold on a filter. This was dried and cupelled.

In one case the residue after chlorination was further treated by agitation with cyanide. The results obtained by chlorination are detailed in the following table:

The residue from test No. 3 (Table X) was further treated by cyanide, by agitation for 4 days with a solution originally at 0.2% KCN, and increased toward the end of the treatment to 0.5% KCN, using a dilution of 3:1. This treatment yielded the following results:

	Gold, Oz.	Silver, Oz.
Final residue after cyanide treatment	0.07	0.87
	%	%
Extraction from chlorination tailing	41.7	19.4
Total extraction from raw concentrate	98.3	18.4

From these figures it would seem that the results to be expected from chlorination, or from chlorination followed by cyanide, are in no way superior to those obtainable by water-washing and cyanide. Either method will give a satisfactory extraction and the choice would depend on relative cost under local conditions.

Direct Cyaniding of Raw Ore

It is interesting to compare the results obtainable on this ore by direct cyaniding without any form of concentration, with those given by the combination of flotation and cyanide.

The following tests were made on portions of the same lot of ore as was used for tests detailed in the preceding tables. Three charges were treated; the first two were taken from a portion crushed in a small tube-mill with manganese-steel balls, using the following quantities:

Ore, 25 lb.; lime, 0.25 lb.; water, 17 lb.

Time of grinding, 6 hours.

The pulp was drained on vacuum-filter to 26.4% moisture.

The third test was made on part of a larger portion of ore crushed in the same manner, but in a larger mill, for use with a 200-lb. flotation machine.

TABLE X

	Test No. 1.		Test No. 2.		Test No. 3.	
Weight of roasted concentrate treated (gm.)	150		125*		150	
1 ton raw = roasted (ton)	0.801		0.788		0.854	
1 ton raw after chlorination	?		?		0.834	
	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.
Assay of raw concentrate	4.92	1.14	4.92	1.14	3.50	0.89
Assay of roasted concentrate	6.24	1.28	6.18	1.30	3.87	1.09
Roasted concentrate, calculated on raw	5.00	1.03	4.87	1.02	3.30	0.93
Residue of roasted, after chlorination	0.14	1.32	0.15	1.33	0.12	1.08
Residue calculated on raw	0.11	1.06	0.12	1.05	0.10	0.90
Actual recovery by precipitation with $FeSO_4$:						
Per ton of roasted	6.09	...	5.49	...	3.84	...
Per ton of raw	4.88	...	4.27	...	3.28	...
Extraction.	%	%	%	%	%	%
On roasted concentrate	97.8	...	97.6	...	97.1	0.9
Calculated on raw	97.8	7.0	97.6	7.9	97.1	...
Recovery from raw concentrate:						
(*a*) Based on residue assays	99.4	...	96.5	...	91.4	...
(*b*) Based on $FeSO_4$ precipitation	99.2	...	86.9	...	93.6	...

*Ground to pass 200-mesh before chlorination.

TABLE XI

Direct Cyaniding of Raw Ore, Without Concentration

	Test No. 1.	Test No. 2.	Test No. 3.
Wet weight of ore taken (gm.)	708	708	100
Dry weight of ore taken (gm.)	521	521	95
Solution added (c.c.)	1,457	1,457	300
Lime added, per ton of ore (lb.)	...	....	21.1
Strength of solution maintained at KCN	0.1%	0.2%	0.2%
Final dilution of pulp	3:1	3:1	3:1
Time under cyanide treatment (days)	5	5	3
Cyanide consumed per ton of ore (lb.)	4.80	6.32	4.76

	Test No. 1.		Test No. 2.		Test No. 3.	
	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.	Gold, Oz.	Silver, Oz.
Head assay	0.625	0.16	0.625	0.16	0.895	0.13
Residue assay	0.205	0.07	0.16	0.04	0.155	...
Extraction, (%)	67.2	56.2	74.4	75	82.7	...

Cyanide Treatment of Flotation Tailing

A flotation test was made on the ore used in Test No. 3 (Table XI), resulting as follows:

		Assay-value.		Per cent of total value.	
	Weight,	Gold,	Silver,	Gold,	Silver,
Product.	%	Oz.	Oz.	%	%
Head		0.895	0.13	...	...
Concentrate ...12.45		6.53	1.04	90.8	99.6
Middling 11.45		0.35	...	4.5	...
Tailing 76.10		0.055	...	4.7	...

The tailing thus produced was agitated with cyanide, with results as shown below.

TABLE XII

Cyanide Treatment of Raw Flotation Tailing
Wet weight of tailing taken, 100 gm.
Moisture, 7.4%. Dry weight, 92.6 gm.
Lime added, 1 gm. = 21.6 lb. per ton of tailing.
Strength of solution maintained at 0.2% KCN.
Dilution of final pulp, 3:1.
Time under cyanide treatment, 3 days.
Cyanide consumed per ton of tailing, 1.40 lb.

	Gold, Oz.
Assay before cyaniding	0.055
Assay after cyaniding	0.0125
Extraction	77.3%

Comparison of Methods

For the sake of comparison, we may assume in view of previous results that an extraction of 98% could be obtained from the concentrate yielded by the above flotation test, by the method detailed, namely, roasting, water-washing, and cyaniding. The values shown in the middling may be eliminated on the assumption that in practice the middling would be constantly returned to the head of the machine, and that finally only two products would be obtained, concentrate and tailing, having the same assay-values as in the test. The result of the flotation test would then appear as follows:

		Assay-value.		Per cent of total value.	
	Weight,	Gold,	Silver,	Gold,	Silver,
Product.	%	Oz.	Oz.	%	%
Concentrate ...12.97		6.53	1.04	94.6	103.8
Tailing 87.03		0.055	...	5.4	....

We have, therefore, per ton of raw ore:	Gold, Oz.	Gold.	Per-centage of total gold.
Recovered from concentrate: $6.53 \times 0.1297 \times 0.98$ =	0.830	$17.16	92.7
Recovered from tailing: $0.055 \times 0.8703 \times 0.773$ =	0.037	0.76	4.1
Total recovery	0.867	$17.92	96.8
Heads	0.895	18.54	100

Taking the figure of Test No. 3 (Table XI) as indicating the possible recovery by direct cyanide treatment we have:

	Gold, Oz.	Gold,	Percentage of total gold.
By direct cyaniding.....	0.74	$15.30	82.7
Additional recovery by combined method	0.127	2.62	14.1

	Per ton of concentrate.
Flotation, 16c. per ton of ore $= \frac{0.16 \times 100}{13}$ =	$1.25
Roasting	1.00
Extra labor, etc., in cyaniding	0.50
	$2.75
Per ton of raw ore, 2.75×0.1297 ..... =	0.36
Net saving by combined method.....	2.26

In addition to this there is a saving in cyanide consumption as follows, per ton of raw ore:

	Cyanide consumed.
By direct treatment	4.76 lb.
By combined treatment:	
Concentrate (say, 5 lb. per ton) 5×0.13 ..... =	0.65 lb.
Tailing, 1.4×0.87 ..... =	1.12
	1.77

showing a saving in cyanide of 2.99 lb.; taking cyanide at 16c. per lb. of KCN equivalent, this would amount to 48c. per ton of raw ore treated, bringing the total saving to $2.74 or about $9600 on a monthly output of 3500 tons.

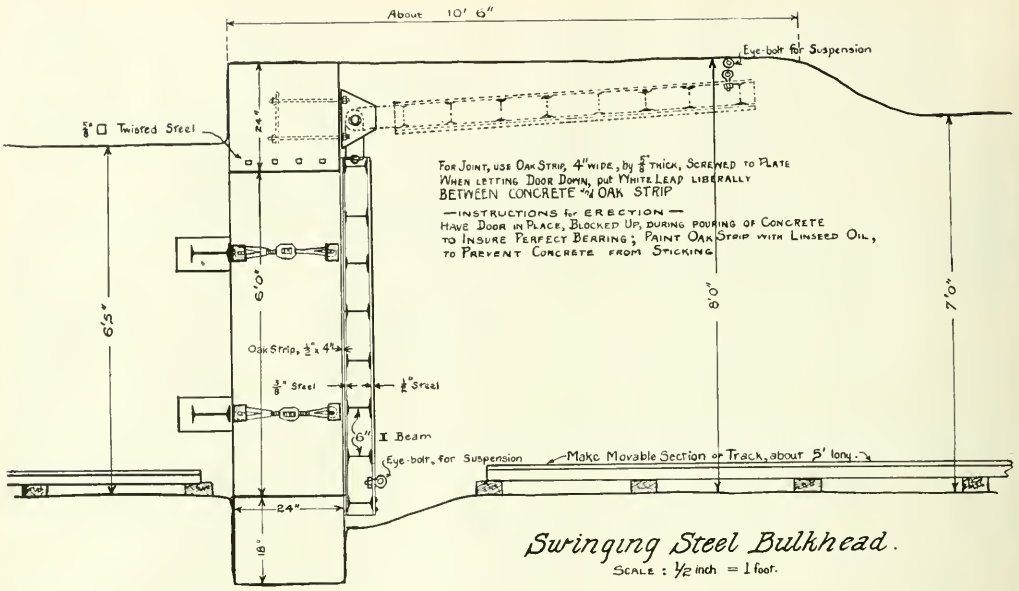
The tests given in Table No. III show that about 0.4% of copper, or 8 lb. per ton of raw concentrate (in this case 2 lb. per ton of raw ore) can be extracted in a soluble form, and might be recovered as an additional source of revenue.

Safety-first apparently is reducing the number of accidents in the Michigan copper mines, according to the report of the mine inspector for Houghton county, Thomas James, for the year ended September 30, 1915. The fatalities totaled 34, in the following mines: Quincy, 7; Champion, 3; Trimountain, 2; Baltic, 4; Hecla branch, 7; South Hecla branch, 2; Calumet, 2; Red Jacket shaft, 3; Isle Royale, 1; Superior, 1; Centennial, 1; and Hecla Amygdaloid, 1. From October 1914 to September 1915, inclusive, the monthly totals were 1, 3, 1, 3, 2, 6, 7, 4, 2, 2, 2, and 1, respectively.

Records since 1910 are as follows:

Year.	Men employed.	Fatalities.	%
1910	16,250	58	0.0036
1911	15,361	51	0.0033
1912	15,554	36	0.0023
1913	13,813	32	0.0023
1914	12,954	29	0.0022
1915	16,005	34	0.0021

Water consumption at mines at Kalgoorlie, Western Australia, is as follows: Five plants treating a total of 69,942 tons of ore per month by the dry process used 202 gal. per ton; while four plants treating a total of 73,981 tons by the wet method consumed 190 gal. per ton. This water costs from 36c. to $1.68 per 1000 gal. The consumption includes everything from drinking water to that used in the power-plants at the mines and mills, and for sluicing away the residue. Water is also used for spraying tailing-dumps. All of the fresh water is supplied from a reservoir 353 miles distant, pumped through 30-in. pipes.


About 10' 6"
Eye-bolt for Suspension
5/8" □ Twisted Steel
24"
For Joint, use Oak Strip, 4" wide, by 1/8" thick, Screwed to Plate
When letting Door Down, put White Lead liberally
BETWEEN CONCRETE & OAK STRIP
—Instructions for Erection—
Have Door in Place, Blocked Up, during pouring of Concrete
to Insure Perfect Bearing; Paint Oak Strip with Linseed Oil,
to Prevent Concrete from Sticking
6'10"
6'5"
8'0"
7'0"
Oak Strip, 1/2" x 4"
5/8" Steel
1/2" Steel
6" I Beam
Eye-bolt for Suspension
Make Movable Section of Track, about 5' long.
24"
18"
Swinging Steel Bulkhead.
Scale: 1/2 inch = 1 foot.

Pumping at the Commonwealth Mine, Arizona

By EDGAR A. COLLINS*

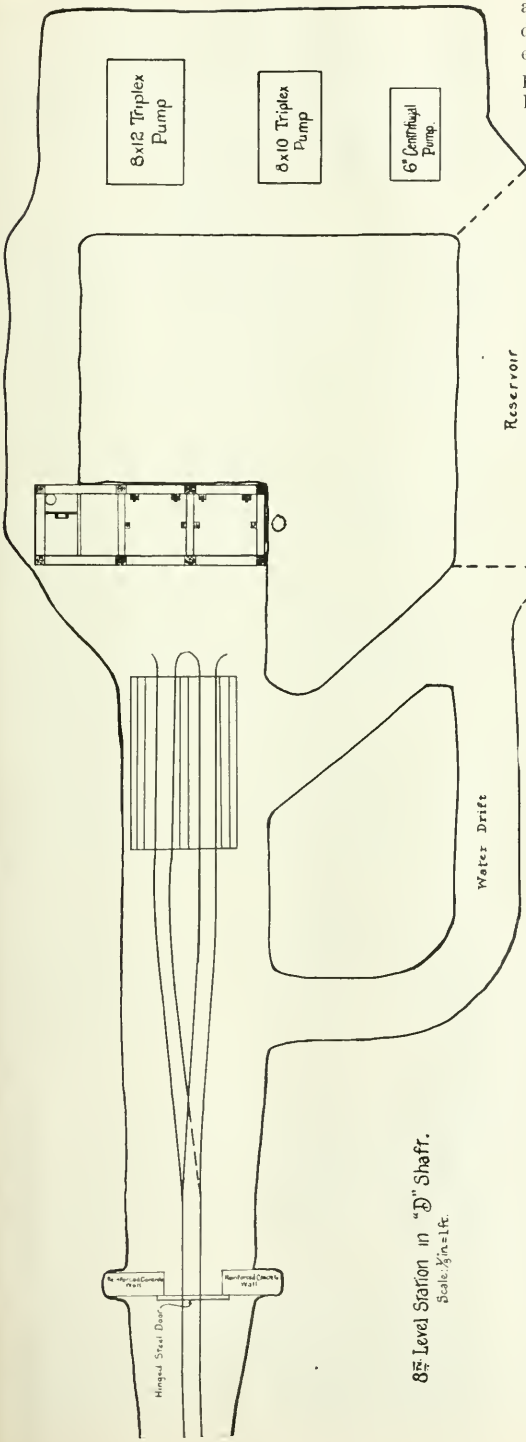
The main or D shaft of the Commonwealth mine is a 60° incline, sunk in the foot-wall parallel with the main vein and distant 100 to 150 ft. from it. The water-level is reached at an inclined depth of 425 ft. or 370 ft. vertically below the collar of the shaft. Former workings below the water-level, while of limited extent, had shown that a large quantity of water would be encountered when greater depth was attained. The vein is a fractured zone that offers a good channel for surface waters. The foot-wall andesite, on the contrary, is softer and close-grained, so that it does not contain much water. This was one of the principal reasons for placing the shaft in the foot-wall and parallel with the vein.

Sinking below the water-level was started in May 1914. The flow of water increased steadily until, at a depth of 485 ft., a fissure was encountered the flow from which taxed the capacity of the two No. 9-B Cameron sinkers. These pumps raised the water to the 7th level (410 ft.), so that their joint capacity was 500 to 600 gallons per minute when working at full speed. On this basis the flow was estimated at 500 gallons per minute. It was the original intention to cut the station for the 8th level at a depth of 510 ft., but after pumping steadily from the sump for two weeks without gaining on the water appreciably, it was decided to cut the station at 485 ft. and install the pumps while the sinkers were able to handle the flow of water. Before starting excavation for a station, the bottom of the shaft was cleaned and all holes and water-fissures plugged and wedged as tightly as possible. This reduced the flow appreciably.

In order to avoid draining the main water-fissure, which dipped into the shaft from the hanging wall at a flat angle, the pump-chamber was 'cut-under,' or in the foot-wall of the shaft. Contrary to expectation, the cross-cut to the vein did not develop any additional flow of water for the first 50 ft. or so, the ground being firm and fairly free from cracks. A suitable place was selected for a bulkhead and, as soon as possible, a steel hinged-door was set in the cross-cut to hold back the water in case of emergency. This door was hung from reinforced-concrete pillars set in the side of the cross-cut. A sketch of this door is shown herewith. It was designed by Otto Wartenweiler, mechanical engineer, of Los Angeles, and proved entirely satisfactory. Provision was made to reduce the water behind the door when it was shut by two valves, and the leakage was easily handled by one of the air-operated sinker-pumps that are kept ready for emergency. This door has been used repeatedly on occasions when electrical power was shut off for sundry repairs at the power-house and has regulated a flow of over 1300 gallons per minute with no trouble whatever. Without a similar bulkhead the pumps would have been flooded on several occasions.

Previous work below water-level, by the old company ten years ago, while not extensive, indicated the probability of a maximum flow of approximately 1000 gal. per minute, and that the normal flow would be consider-

*Manager of the Commonwealth mine.



ably less than 750 gal. per min. On this basis it was decided to install two separate units of 750 gal. per min. each. It was realized that the motor-driven centrifugal pump would be cheaper in first cost and would occupy less room with a little higher consumption of power, but the question of reliability of operation and general efficiency seemed to favor the plunger-pump of the triplex type. It was, therefore, decided to provide one unit consisting of two triplex plunger-pumps (one of which was already on the ground) and a second unit consisting of a 6-inch four-stage centrifugal pump with a rated capacity of 850 gal. per min. Therefore, specifications were sent to various manufacturers asking for quotations and efficiency guarantees, and after careful consideration the following equipment was selected:

One 8 by 12 Aldrich triplex pump, capacity 450 gal. per min., driven by double helical gears and direct connected to a General Electric motor of 75 hp. and 514 r.p.m. Weight, 25,500 lb.; price, delivered, $3264.

One 6-inch four-stage Alberger type S-turbine centrifugal pump with bronze impeller and diffusion-vanes, direct-connected with flexible coupling to a 150-hp. General Electric induction motor. Weight, 7835 lb.; price, delivered, $2128.

The Alberger Pump & Condenser Co. guaranteed a pump-efficiency of 70% and an over-all efficiency of 64.2%. No accurate efficiency-tests have been made, but it is believed that the results will closely approach this guarantee.

All three pumps have given satisfactory service. This is particularly the case with the centrifugal pump, which has been in practically continuous operation since it was started. A little trouble was experienced in starting the pump owing to faulty lubrication in the thrust-bearing, which is of the marine type. With the exception of the first month, however, this pump has only been shut-down when power was lacking. For the first two or three months it was possible to shut-down one or other of the plunger-pumps for short intervals. During the last six months, however, they have been steadily in operation and, except when power was lacking, have been shut-down only for short intervals to overhaul valves, etc.

About 667 cubic yards of rock was excavated for the pump-station and reservoir at a cost of $8.57 per cu. yd. The total cost of the entire station and equipment, including the extra electric wiring necessary, piping in the pump-chamber, steel bulkhead-door, etc., was $13,729, of which $8344.75 was the cost of the pumps and $3645.61 was paid for labor, as shown by the following table:

PUMP CHAMBER AND EQUIPMENT.

Labor	$ 3,645.61
Piping	800.06
Wiring	341.76
Steel bulkhead	186.62
Pumps	8,344.75
Miscellaneous	410.22
Total	$13,729.02

Actual pumping operations with the new equipment commenced in September, but regular records were not kept until the following month. At that time and at intervals since then weir-measurements have been taken of the quantity of water flowing to the sump. Checks were also taken of the amount delivered at surface by the different pumps. These were rough measurements and can be considered only as approximately correct. Readings of the current for the pump-motors have been taken from time to time; these show little variation in consumption of power. From the measurements the following pump-duties have been figured.

	Gallons per minute.	Power-consumption.
8 by 12 Aldrich triplex	440	70
8 by 10 Aldrich triplex	350	62
6-in. Alberger centrifugal	740	133

During the last six months a total of 383,277,000 gallons of water has been pumped to surface, equal to a daily average of 2,000,000 gal., at an average cost of 4.4c. per thousand gallons. The various items of this expense are shown in the following table.

DETAILED PUMPING COST, 6 MONTHS, MARCH TO AUGUST 1915, INCLUSIVE

Total water pumped, 382,277,000 gallons.

	Total.	Cost per 1000 gal.
Labor	$ 2,611.09	$0.0069
Supplies	801.37	0.0021
Electric power	13,158.00	0.0344
Compressed air	374.81	0.0010
Total	$16,945.27	$0.0444

Power is supplied from the company's steam-driven engine-generator plant and the average cost, including all renewals, maintenance of boiler plant, etc., was 0.016c. per kw-hr. or $8.57 per hp. month. In this connection it is fair to state that the power-plant is overloaded considerably at present and the condenser is unable to maintain a high vacuum. For this reason the cost of power is above normal during the summer months.

An interesting development of the pumping program has been the recent unwatering and recovery of a duplex plunger triple-expansion Dow steam pump at the 8th level of the old B-shaft. This pump has been under water for ten years, but was found to be in excellent condition. With the exception of a thin coating of rust on the outside, the pump was practically uninjured by its long stay under water. This is, of course, mainly due to the fact that the mine-water is unusually pure and slightly alkaline. As a matter of fact, it provides the domestic supply for the town of Pearce. This pump has since been overhauled, cleaned, and tested, and is now ready to serve as part of a duplicate unit for the old or C-shaft which is being sunk to the 10th or 570-ft. level. It is an efficient and economical pump, but as an illustration of the development of modern pumping practice it contrasts sharply with the electrically-driven centrifugal pumps, which will form part of the same unit, and which handle an equal quantity of water while occupying only one-twentieth of the space.

CHILE has an area of 292,100 square miles, which is well above that of the state of Texas, and a population of 5,000,000, which is greater than that of California, Oregon, and Washington combined, while Santiago, the capital of Chile, has 500,000. With an average breadth of only a little over 100 miles, it has nearly 3000 miles of coast backed for its entire length by the lofty and unassailable rampart of the Andes. The southern part is heavily wooded, while the north is an arid upland plateau containing important mineral products, nitrates, copper, and iron ore. The Chilean government has never yet passed a payment on its bonds, and it subsidizes a line of steamships plying between its own ports and as far north as the Isthmus of Panama. To an extent unusual in South America, the settlement of the country has been practically homogeneous; the European element composes the governing and wealthy class, and forms the backbone of the nation; this is a point of tremendous importance in the future development of the country. The Chile Copper Co., owning the Chuquicamata mines, is aiming at a production of 120,000,000 lb. of copper per year by its first unit of 10,000 tons of ore, daily capacity, at a cost of 6 cents per pound. Shipment of iron ore from the Bethlehem Steel Co.'s Tofo mines has been increased in the last year from 20,000 tons to 40,000 tons per month; an aerial tramway transports the output of the mines five miles to the coast. Iron and steel manufactures, electrical and mining machinery, form important shipments from the United States to Chile.

TABLE showing number of claims ordered surveyed for patent in Utah, during 1913, 1914, and January to September 1915.

District	1913	1914	1915
Bingham	1	4	24
Big and Little Cottonwood	3	8	25
Park City	21	5	26
Beaver County	4	9	11
Tintic	2	18	4
San Juan County (carnotite)	0	0	81
Emery County (carnotite)	0	0	2
Bull Valley	16	0	0
Piute County	1	23	3
Deep Creek	11	6	0
State Line	2	2	0
Miscellaneous	30	2	0
Total	91	77	176

LIMESTONE SAND is being used for concreting the Sacramento shaft of the Copper Queen mine, Arizona. Tests show that this material makes a stronger concrete than ordinary quartz sand.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

GOGGLES should be worn by men using emery wheels; and safety-collars should be fitted to the wheels to prevent them from bursting.

THE STATIONS where telephones and first-aid apparatus are placed in mines should be marked by distinctive lights, as is done with powder-magazines.

COST OF LIGHTS in mines is as follows: oil torch, 6 to 10c.; oil safety-lamp, 7 to 9c.; electric lamp, 12 to 17c. per week. Belgian coal mines use the electric lamp extensively.

DREDGING AND HYDRAULICKING in the state of Victoria, Australia, has yielded a total of 1,004,034 oz. gold, from 219,851,948 cu. yd. since 1900. The average was 4.4c. per yard. During this work there was 650 tons of tin saved.

GALVANIZED-WIRE ROPE cannot be safely employed for hoisting or haulage work. The constant bending over sheaves or drums causes the zinc to scale off, leaving the rope in bad condition. Such ropes can be used for guys and similar purposes.

WHERE large square timbers are not available for head-frames or other heavy purposes, satisfactory timbers may be built by spiking boards or planks together. If the timber is to be framed, care must be taken that no nails or spikes are driven where mortises are to be cut.

TO ASCERTAIN the distance a body will fall (theoretically) during a given time, square the number of seconds and multiply by 16.08 ft., the distance through which the body falls during the first second. To fall 5000 ft. requires about 18 sec. The practical effect of the resistance of the atmosphere varies with the form and specific gravity of the falling object.

GALENA is nearly twice as heavy as pyrite. On the other hand zinc-blende and pyrite are so nearly identical in specific gravity that the practical separating of them by concentration is much complicated. One of the great troubles at Broken Hill was the separation of the blende and rhodonite; but flotation, as evolved there, solved the difficulty.

ELECTRIC PRODUCTION of iron is making rapid progress in Sweden, a country of large water-power development. There are 11 furnaces in operation, from that of 2500 hp. at Trollhätten to 10,000 hp. at Domnarfvet. Kilowatt-hours consumed at the Trollhätten furnace per ton of pig-iron are 2116; iron produced per horse-power year, 3.05 tons; and consumption of electrodes, 4.14 kilograms per ton of iron.

NATIVE SILVER found in the copper mines of the Lake Superior region for many years belonged, by custom, to the miners discovering it, if they were working by leasing. Now, of course, all valuable minerals go to the company.

DOLOMITE, a magnesian limestone, is being successfully substituted in basic open-hearth furnaces for magnesite, on account of the scarcity of the latter. When it is doubly burned, to thoroughly gasify it, it is found to be a good substitute. One disadvantage is its tendency to slake if a furnace is shut-down for a little time.

THE RELATION between kilovolt-ampere and kilowatt may be expressed as follows: kva. multiplied by power-factor equals kw. For example, in alternating-current practice, if voltmeters and ammeters are used to measure the potential and current, the product of voltage by amperage by 1000 equals the number of kva. being carried on the line. This, however, does not represent the work done unless current and potential are in phase, when current flows against resistance only, there is no inductance, and the power-factor is 100%. If there be a lag or lead of the current with respect to the potential, the two are not in phase, and the work done is not represented by the afore-mentioned product, but a further multiplier must be introduced, namely, power-factor, in order to find the work done. Suppose the potential and current measured are found to be 2200 volts and 113 plus amperes, then the kva. is 250. This is not the work done if the power-factor is, let us assume, 80%; the work done is then 250-kva. times 0.80, or 200 kilowatts.

MINERS of the Joplin district, Missouri, and their families are practically all of American stock. Many of them are only one or two generations removed from the Tennessee mountains and the Arkansas farming country, and as they drift into mining work are most often fresh from Missouri farms. These people are intelligent, independent, and industrious; as a rule they marry young, and large families are frequent, according to A. J. Lanza, of the U. S. Bureau of Mines. Their efficiency, as far as labor in the mines is concerned, is high, and probably not exceeded in any other mining community in this country. Many of them prosper in mining, and it is a common saying in south-western Missouri that every miner is a prospective operator. Although the sanitary environment of their homes often leaves much to be desired as regards its bearing on public health, the faults are essentially due to a lack of knowledge of the effect of certain practices. The men receive good wages. It is probable that sanitary education would not only be well received in the communities in the Joplin district, but would work a great deal of good.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

PLATTEVILLE, WISCONSIN

General Conditions During October.—Prices for Zinc, Lead, and Pyrite.—District Outputs.—New Work.

Ideal weather prevailed in the zinc region during October, resulting in an output of nearly 50,000,000 lb. of concentrate, the greatest in the history of this field. Heavy buying by eastern smelters unloaded the bulk of the reserve product found here at the beginning of the month, in a quarter heretofore inconsiderably engaged in the field, leaving the regular buying interests to pursue their usual vocation without much competition. Capital from new and unexpected sources flowed in. Building operations were favored by the good weather and mild temperature. In conjunction with State and local authorities, the more prominent mining corporations did substantial road construction, and macadam roads will soon be completed. The personal comfort of miners was not overlooked, several of the companies providing commodious modern change-houses, and numbers of cottages were built for miners at low rent. In some districts not a foot of land is now available for leasing, and scores of drill-rigs are working night and day.

In the first two weeks of the month, ore-buyers exercised caution in submitting offerings which had receded from above $80 per ton for 60% concentrate, to a range on which sales were being made from $70 to $75 per ton. Buyers representing the smaller smelter interests were restricted in their activities under instructions from headquarters, compelling bids on products above 55% zinc and on a base of $70 per ton. Under the circumstances the larger smelters, such as the New Jersey Zinc Co., Matthiesen & Hegeler Zinc Co., and Illinois Zinc Co., secured the bulk of the higher-grade offerings. Then came the turn as abrupt as pleasing: the smaller concerns began to set the pace, giving proof that the larger buyers referred to were paying advanced prices, and quotations cleared $10 per ton at one rise, bringing the price for top grades to $85 per ton. This quote held at the close of the month at a par with the prices that usually obtain in the Joplin field, but unlike the Joplin markets, remained stationary. Miners all over the field expressed their views that they were not getting a price for their product commensurate, or even nearly so, with the selling price of high-grade spelter, and there were peristent rumors of determined efforts to secure more satisfactory prices, or refuse to sell their products. More high-grade zinc ore was cleared from the Wisconsin field during October than ever before. The reserve, which amounted to several thousand tons at the beginning of the month, was entirely eliminated.

Lead-ore producers made substantial gains also. Efforts on the part of large smelters to stimulate buying failed, but a much improved tone became apparent at the end of October. Pig-lead rose to about $4.85 per 100 lb. Lead-ore producers found a better demand, but expecting higher prices, decided to hold their product. Sales were large at the close of the month, and more lead ore went to market than for any single month this year. The remainder is held, $55 per ton not being regarded as a satisfactory offering.

Pyrite held at stagnant figures, bringing about $3.75 to $4 per ton, on a basis of about 12c. per unit, the bulk of ore sold coming from the separating-plants, and containing 35% sulphur.

Carbonate-ore producers unloaded some finished product with the Lanyon Zinc Co. Missouri calamine quotations govern this product in Wisconsin and while $65 per ton was reported at intervals in the former State for 40% ore, the best that Wisconsin miners could do was $35 per ton for ore assaying about 35% zinc. The New Jersey Zinc Co. started a cleaning-up program on its holdings in the field, seemingly doing better on old dumps, gutters, and waste-heaps, than it accomplished with a large force of miners working underground. Much ore was left in the hands of small operators at the close of the month.

Deliveries of products in October were as follows:

District.	Zinc pounds.	Lead pounds.	Pyrite pounds.
Benton	14,388,000	330,100	.....
Mifflin	7,718,000	326,000	.....
Cuba	5,934,000	.....	2,267,056
Hazel Green	5,112,000	86,400	.....
Galena	4,446,000	.....	.....
Platteville	4,678,000	104,130	.....
Linden	3,274,000	149,650	.....
Shullsburg	1,380,000	.....	.....
Highland	738,000	.....	.....
Potosi	134,000	50,000	.....
Mineral Point	108,000	.....	.....
Dodgeville	.....	204,000	.....
Totals	47,910,000	1,250,280	2,267,056

The gross production of crude concentrates was about the same as reported in the deliveries; net refined ores direct to smelter, and concentrate out of the field, were 26,000,000 lb. The Mineral Point Zinc Co. followed a strenuous ore-dressing campaign, and shipped 2320 tons of high-grade separator product to the Nassau works, at DePue, Illinois.

Several new producers commenced; 10 new plants are rapidly nearing completion; two new separating-plants were started, and one will be put in commission during November; the acid-works connected with the plant of the New Jersey Zinc Co. at Mineral Point goes into service on November 15; rich discoveries of ore were numerous; and the drilling program is tremendous.

BOSTON

Report on Alaska Gold Mines Property.

Regarding the Alaska Gold Mines property, D. C. Jackling, the managing director, has issued the following statement:

"We shall not be able to achieve the expected results as soon as we had anticipated. We have encountered an unlooked-for intrusion of low-grade schist on the 5th level, from which point we had expected to draw high-grade material with which to sweeten up the known lower-grade ores, as we mined them near the surface. Notwithstanding thousands of drill-hole tests, we strangely enough did not cut into this low-grade intrusion. It will take us three or four months to get this material out of the way, and put the mine in shape to supply average ore to the full capacity of the mill. It is the inevitable disappointment which accompanies the development of a large property.

"For a time we were puzzled to know what had happened. Two stopes on the 5th level had run into something which completely upset our calculations. As soon as we ascertained the real status of affairs, we knew we would be delayed in open-

ing-up stoping ground of the desired average grade to feed 8000 to 10,000 tons daily to the concentrator. For some little time we shall continue to show smaller returns than anticipated.

"Up to the end of October we had treated in our new plant about 900,000 tons of ore, assaying about $1.25 per ton instead of the expected $1.75 per ton. We are now mining and milling for 60c. per ton, and have got our tailings losses down to 20c. per ton. These figures compare with an estimated cost of 75c. per ton and tailings losses of 25 cents, so that in increased operating economies we have an offset of 20c. per ton against the temporary low average ore yield. Including the 400,000 tons milled in the old plant, the average net assay value to date is brought up to $1.30 per ton.

"I might mention that never before in the history of mining has ore been mined from underground workings, hauled under ground a distance of two miles, hauled again to the mill, a distance of over two miles more, and put through a concentrator for a total cost of only 60c. per ton.

"Just now we are treating 5000 tons of ore per day. I think we will raise the tonnage next month to 6000; by the first of the year to 7000, and soon thereafter to 8000 tons. The next 2000-ton increase will come more slowly by reason of the delays already explained. Our milling plant is a marvel; it is more than meeting our expectations. It is the most efficient plant of its kind in existence, and we have more ore than can be mined out in a generation.

"There are always to be found timid souls who seem unable to stand up and face discouragements and annoyances which mining men accept as part of their business. When we were opening up the Utah Copper property, we were informed from the outside that our ore was too low in copper tenor to permit of a profit. All sorts of dire predictions were kindly sent to us. At Ray Consolidated and Chino also it was said we had run up against insurmountable problems. But we worked out of them all, until today at all of our properties we are milling no less than 21,000,000 tons of ore a year. Every one of these companies has money in the bank, is paying good dividends and does not owe a dollar.

"Alaska will prove all that was ever claimed for it, but we will be delayed a little in 'getting there;' that is the situation in a nutshell."

A broker's circular contains the following:

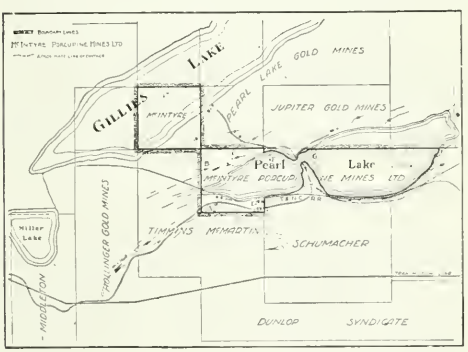
At the Alaska Gastineau company's mine eight stopes have been finished and are in actual stoping condition, five are in process of being prepared, and two more are being developed. Altogether there are now about 1,000,000 tons of broken ore in the mine. Ore has been delivered at the rate of 5500 tons per day, and this is now being raised to 7000 tons. The mine will easily be able to furnish ore to the full capacity of the mill by the first of the year. The Sheep Creek railroad is proving capable of handling 20,000 tons of ore per day. In the milling division the coarse and fine-crushing plants are now practically completed, and are able to treat easily up to 10,000 tons of ore per day. In the concentrating department the two units have shown a capacity in excess of 2500 tons each. Tailing is less than 20c., and should eventually, be not over 17c. The ratio of concentration has been increased from 350-1 to 750-1. The permanent re-treatment plant and the refinery are now ready. In the power division the Salmon Creek dam continues full and overflowing, and this plant is able to deliver all the power required for present operations. At the Annex Creek scheme, where additional power is being developed to care for the excess capacity of the mill, the plant should be in operation before the first of the year, so that after that date there will be power sufficient to treat all the ore that the mine and mill can handle. In the seven months that the property has been operating, the tonnage furnished by the mine and treated by the mill has increased rapidly for a new enterprise. Starting in March with 40,000 tons, the quantity has increased month by month, until in September there was approximately 132,000 tons treated. The average so far has been $1.50 per ton, with costs of 65c. per ton.

TORONTO, ONTARIO

Porcupine Mines: the Dome, Hollinger, Schumacher, and McIntyre.—Swastika, Kirkland Lake, Boston Creek, and Le Pas Districts.

The Dome company at Porcupine beat all previous outputs during October, with a production of $150,500 from 28,750 tons averaging $5.24 per ton, compared with $4.83 in September. ——The Hollinger also showed an increased return during the four weeks ending October 7. The gross profit was $158,342 from the treatment of 27,029 tons assaying $9.66 per ton; the working cost was $3.19 per ton. In addition to its own ore the Hollinger mill treated 10,990 tons from the Acme mine.—— The Schumacher has been added to the list of Porcupine producers, the yield during October approximating $20,000.—— Shareholders of the McIntyre company ratified the agreement made by the directors for the purchase of the Jupiter, which will accordingly be operated in connection with the McIntyre and Pearl Lake mines.

The directors of the Lucky Cross in the Swastika district,



THE MCINTYRE-JUPITER-PEARL LAKE AREA, PORCUPINE.

which is controlled by Philadelphians, have been inspecting the mine. It has been closed down for two years, and they propose to resume operations as soon as finances can be arranged.——In the Goodfish Lake area of the Kirkland Lake district, the La Belle Kirkland mine promises to become an active producer. A 25-ft. vein, which only showed traces of gold at the surface, is yielding high-grade ore at 100-ft. depth, where it has been opened for 100 ft. Five promising veins varying from 5 to 25 ft. wide have been cut. A compressor and hoist will shortly be installed.——The Beaver Consolidated of Cobalt, following the example of many other silver-mining companies, is getting interested in the gold areas, and has purchased 10 claims belonging to the Kirkland Lake Gold Mines.

A Detroit syndicate, represented by George C. Miller, general manager of the Miracle mine at Porcupine, has purchased control of a claim belonging to Fred. Connell and J. McDonough in Pecand township, near Boston creek. It shows ore of such richness that the owners have an armed guard in charge, having in view the wholesale and unscrupulous manner in which the King Dodds mine at Kowkash was plundered.

A good deal of attention is being directed to the Le Pas mineral area in northern Manitoba, situated some 74 miles north of Le Pas, and extending about 125 miles from near the western boundary of the province east toward James bay. The mineralized belt is about 50 miles wide, of Huronian formation, being largely conglomerate and Keewatin schist.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

JUNEAU

Grading for the Alaska-Juneau mill is nearly finished; excavation follows. The mill-site is very steep. A great deal of lumber is being unloaded at the mill dock.

If $75,000 can be raised, and permission granted by the Department of War, a bridge is to be constructed across the Gastineau channel, connecting Juneau and Thane with Douglas and Treadwell. The strait is about two miles wide.

Orders have been placed this week by the Bradley, Bruff & Labarthe of San Francisco for a quantity of the equipment for the new Alaska-Juneau mill. Detailed information as to the successful bidders will be published in next week's issue. In the meantime it is of general interest to know that the grading for the coarse-crushing section of the mill will be completed on the 20th. The excavations for the main section of the mill proper, with the power-plant, and auxiliaries, are being pushed to completion rapidly, and it is expected that the pouring of concrete will be commenced within 30 days. This is the most important mill construction work that has been undertaken for a long while, and will include many innovations in what has been recognized for some time as standard mill-practice.

KETCHIKAN

(Special Correspondence.)—During the last two months 1200 tons of 3½% copper ore has been shipped from the Mt. Andrew mine; about 600 tons more has been mined and is waiting transportation to the smelters. Preparations are being made for shipping at Big harbor. A tram is being built from the lower workings to the harbor, a distance of about 1700 ft. The ore is medium-grade copper containing some gold. This mine has been developed to a considerable extent during the last 2 years.

The Rogers mine near Hollis has recently been opened to a depth of 350 ft. The ore-shoot is said to be about the same in both width and value as it was in the upper workings. Considerable driving has also been done, resulting in cutting another ore-shoot. The ore mined during development has been treated in the 5-stamp mill on the property.

Ketchikan, October 25.

ARIZONA

COCHISE COUNTY

The Copper Queen company has developed a large quantity of 3% ore in its Sacramento hill, and to treat this a mill with two 1500-ton units is to be erected. Preliminary work will soon commence.

GILA COUNTY

During the quarter ended September 30 the Magma Copper Co. produced 1,973,960 lb. copper at 5.72c. per pound. The price received was 18.78c. The profit was $238,490, equal to $4 per share per annum, and $47,000 greater than in the preceding term.

At the Inspiration mine electric haulage underground has been displaced by compressed air locomotives. The Ray company at Ray is also reported to be about to use air.

GREENLEE COUNTY

On November 8 part of the militia was withdrawn from Clifton, as the strike situation continues quiet.

MOHAVE COUNTY

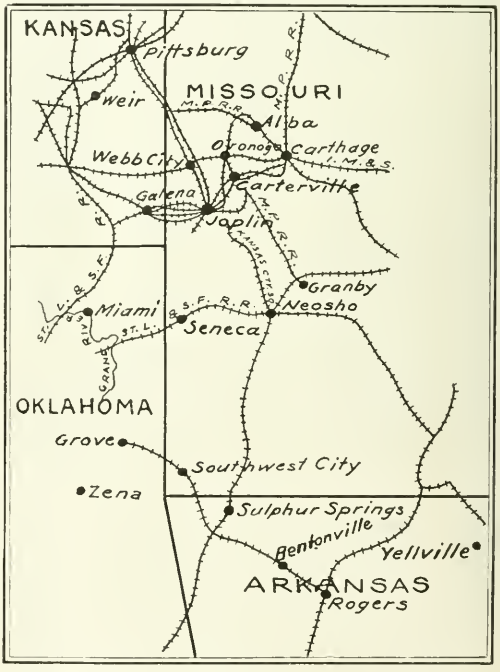
In the weekly news-letter of O. A. Turner of Kingman, a lot of interesting data is given on the mining centres of this county, producing mines, markets for ores, railroad rates and fares for ore and passengers, wages paid, and properties being developed. Oatman now has a population of 1300, an increase of 800 in four months.

At 280 ft. in the Golconda Extension zinc mine, shipping ore has been opened. The main shaft is being sunk to 500 ft. Dumps are estimated to contain $100,000 in zinc, gold, and silver. James Meikle is manager. The mine is in the Wallapai district.

ARKANSAS

MARION COUNTY

As the zinc regions of south-eastern Missouri, south-western Kansas, and north-eastern Oklahoma, are generally included under the heading of the Joplin district, it is suggested that the north-western zinc area of Arkansas be included, all being contiguous. The October production of the north Arkansas field was worth $120,000 for the zinc. Mines north and south of Yellville produced 1750 tons of blende. A number of mills are to be erected.



THE MISSOURI-KANSAS-OKLAHOMA-ARKANSAS ZINC REGION.

The Red Cloud mine at Rush is the largest zinc producer in Arkansas. The output in October was 250 tons of carbonate ore. E. Zimmerman is in charge.

Last week $100 per ton was paid for concentrate here.

CALIFORNIA

A good fall of snow is reported from most of the mountain counties, ensuring a good supply of water in the spring for hydraulicking, power, and other purposes.

Amador County

The Plymouth Consolidated company is sinking a shaft to 1200 ft. at the Montezuma mine, Nashville, Eldorado county. Three shifts of 20 men each are employed.

Four miles from Plymouth the Bay State mine is being reopened.

Butte County

At Oroville there are now only nine dredges at work, compared with four times that number several years ago. The Natomas Consolidated has three; Oro Light & Power, two; Oroville Dredging, two; Oroville Union, one, and Pacific, one.

Mono County

The Masonic district is looking brighter, due to renewed work at several properties, especially the Serita.

The Keane Wonder company's mine and mill, which were in financial difficulties, have been acquired by the Frances-Mohawk Mining & Leasing Co. of Goldfield, and others.

Nevada County

A change-house of 250-miner capacity is being erected by the North Star company at its Champion mine.

Shasta County

(Special Correspondence.)—The discovery of manganese ore in the Arps mine, near Copper City, has stimulated the search for manganese in the east side area of the Shasta copper belt. The deposit on the Arps has been traced for approximately 1200 ft., and is about 125 ft. wide. Samples of the ore assay 40% metal. Previous to the recent acquisition of the property by C. L. Wilson, of San Francisco, attention was paid solely to copper-bearing ore, and the presence of manganese was unsuspected. It is thought that this ore occurs on neighboring claims, and prospecting is active. The Arps is only a few miles from the Heroult smelter of the Noble Electric Steel Co. devoted to production of ferro-manganese and ferro-chrome. A shipment of manganese has been received at Heroult from the Woolley claims near Clipper Mills, Butte county, and is being tested.

The Mammoth Copper Co. has completed several improvements to its bag-house. Three blast-furnaces are in operation, and about 300 tons of Balaklala ore are treated daily, in addition to the ore from the Mammoth mines, and custom ores from several small copper and gold producers.

Operations have been resumed at the Menzel mine, on Flat creek, and 200 tons of ore on the old dump will be sent to the Mammoth smelter. Arrangements have been made for an electric power-line to the property, and unwatering of the shaft, which will be deepened. The mine was re-opened by Frank D. Earbert and M. A. Meagher.

The long drift from the 1300-ft. level of the Gladstone mine, at French Gulch, is expected to cut the orebody within two weeks. The vein yielded much rich ore in upper levels. Production has been curtailed pending further developments. Work is going on in the Five Pines, Summit, and other small mines in the French Gulch field.

Redding, November 15.

At Kennett the Mammoth Copper Co. is erecting a zinc-oxide plant to work in conjunction with its smelter bag-house. The company is laying a 4000-ft. air-pipe to the Friday-Lowden mine, after which the 4000-ft. adit will be started to open the Mammoth ore 500 ft. below No. 5 adit.

COLORADO

Clear Creek County

(Special Correspondence.)—Two feet of smelting ore has been cut in the winze being sunk on the Gunnell vein from the Argo adit-level, assaying $60 gold per ton.

G. K. Kimball and others, leasing at the East Lake mine, have opened 18 in. of ore that is settled at $35 gold per ton at the mill. Work is done through the Big Five adit.

August Swanson & Co., leasing on the Centennial vein of the Imperial Mining Co.'s estate, is shipping two carloads of ore per week, realizing an average settlement of $50 per ton in gold, silver, and lead. Stoping is in progress on a two-foot shoot.

The upper adit being driven on the Aetna vein of the Capital M. & T. Co.'s holdings, has cut 14 in. of lead ore, assaying 40 oz. silver, 0.50 gold, and 35% lead. Johnson & Kane are driving under contract, but hold leasing privileges.

Work was resumed last week on the Golden Glory adit on Saxon mountain. The opening has been advanced for 1720 ft., and a large cave near the breast is now being caught up, before extending the adit another 200 ft. J. F. Prichert is manager.

Large shipments are going out from the Linn mine on Democrat mountain. The 50-ton mill is working steadily and a good grade of concentrate is produced.

Idaho Springs, November 8.

In the East Argentine district J. C. Davis has found rich silver ore. During his prospecting he found some heavy rock thrown out from grading on the Argentine Central line, which on being analyzed proved to be high-grade wolfram. The deposit from which the mineral came is 14 in. wide. A rush has set in.

At the Capital mine the company and lessees are getting good returns. The mill is working, and shipping concentrate. ——The Malm mill is to be operated by the Colorado Metal Mining Co.——Lessees at the Waldorf and Onondago mines are also busy.

During October the W. J. Chamberlain Ore Purchasing Co. at Georgetown settled for over $14,000 of ore. There was 366 tons of ore marketed. The district is busier than for years.

Gilpin County

At a distance of over 665 ft. in its adit at Apex, the Pioneer Mining, Milling, Power & Tunnel Co., composed of Boston and New York people, a large lode has been opened, parts of it assaying high in gold, silver, and copper. The company has built a dam, power-plant, and stamp-mill, which will be started at once.

Concentrate from the Senator mine, below Black Hawk, have been settled for at 1.44 oz. gold, 23.75 oz. silver, and 11% lead, equal to $44 per ton; another lot realized $83.36 per ton.

Gunnison County

Mining has been quiet at the old centre of Vulcan, but a resurrection seems at hand, as the Good Hope, Vulcan, and Mammoth Chimney mines have been sold to Denver people. A 40-ton copper smelter is planned, also a hydro-electric plant.

Lake County (Leadville)

At the Penrose shaft of the Down Town property the pumps are working at 660 ft., lifting a large quantity of water.

An electric hoist is to be installed at the Matchless No. 6 shaft, costing $1350. Lessees have opened large bodies of high-grade iron ore in No. 5 and 6, from which the A. S. & R. Co. requires 1500 tons per month. In No. 7 32% carbonate of zinc ore is being mined.

Mineral County

(Special Correspondence.)—Lessees, employing about 10 men altogether, are working on the Bachelor, and are shipping about 150 tons per month.

Lessees at the Commodore are producing about 250 tons per month.

The Del Monte & Chance Mining Co., operating the Last Chance-Del Monte-New York, is shipping about 250 tons of ore per month.

The Mineral County Mining & Milling Co., operating the Creede United property and the Humphreys mill, is mining about 2500 tons of ore per month, from which is produced

about 350 tons of lead concentrate. It is also making a small amount of zinc concentrate, which is being stored at present. The ore is coming chiefly from the Happy Thought mine. The company is driving north on the Park Regent ground to prospect the Amethyst vein beyond the known orebodies. Two shifts are employed in the mine and one in the mill, about 65 men altogether.

The Syndicate Mining Co. of Kansas City, which owns some claims west of the Bachelor ground, is driving a cross-cut from the Nelson adit to prospect its property.

Schroder is doing some prospecting work on his claims south of the Bachelor.

Lessees are shipping a little ore from the Solomon.

It is reported that a combination of several of the companies owning ground on the Amethyst vein, to pump out the old Commodore shaft below the level of the Nelson adit, has been effected.

The fluorspar mine at Wagon Wheel Gap is being prepared to resume production. A tramway to bring the rock from the upper adit to the valley has been built, and shipping will be resumed shortly. The fluorspar is used as flux in the steel works of the Colorado Fuel & Iron Co. at Pueblo.

It is reported that some Del Norte people who are prospecting on Bear creek, 30 miles up the Rio Grande from Creede, have opened a vein of rich sylvanite ore, and will soon commence shipping.

Creede, November 6.

San Juan County

Ore shipments from Silverton in October totaled 134 cars.

At the Anti-Periodic property on Galena monntain near Silverton, the Rein adit is in 450 ft., and the vein is expected at any time, as the country-rock is mineralized and water increases.——The Garryowen adit is also in promising ground.——Development at the Buffalo Boy is encouraging.——The All O. K. adit is expected to cut ore soon.

The United States Mining Co. is to resume work in the Silverton district, in charge of E. C. Condit.——Eastern people are investing in the American Mining & Power Co.'s property near the Sunnyside mine.

Summit County

The Breckenridge district grows busier through its activities in gold dredging, lead-silver and zinc ores, and molybdenite mining. Flotation has been installed in the Montezuma and Philadelphia mills.

Teller County (Cripple Creek)

Three carloads of ore from a new shoot on No. 15 level of the Gold Sovereign mine on Bull hill were settled at 2.07, 2.24, and 2.17 oz. gold per ton respectively. The Union Leasing Co. has this ground.

The southern slope of Tenderfoot hill is very active on account of prospectors and lessees' work. Four properties are shipping ore; early in the year there was only one.

IDAHO

The extensive gravel areas in the northern part of this State and western Montana, which were worked years ago in a primitive manner, are receiving attention from Spokane people, who will commence work in the spring. L. F. Connolly, and his brother J. Connolly, of Spokane, are preparing to mine 400 acres on Tyson creek, a tributary of St. Maries river. Test by hydraulicking has been done this season, and by next June a plant costing $20,000 is to be erected. $30,000 net per acre is expected. Along the Yaak river Lincoln county, Montana, the Kootenai Hydraulic Mining & Power Co., of Spokane, will develop and sluice on its 1600 acres next year. Flumes, pipes, and hydraulic plant will cost $50,000. The gravel contains from 10c. per yard up.

The Orofino coalfield in Clearwater, Lewis, and Idaho counties is the subject of Bulletin 621-I of the U. S. Geological Survey, by Charles T. Lupton. He concludes as follows: The inferior quality of the coal and the fact that extensive prospecting in this region has failed to reveal coal in commercial quantities, suggest that the field will be of no importance as a producer of coal or lignite except in a very local way. It is questionable if any additional information regarding the coal or lignite possibilities of the general region, of sufficient promise to justify further prospecting, will be found, and the expenditure of time and money in such work is not advised.

Lemhi County

(Special Correspondence.)—At the Queen mine, north of Salmon, where work was resumed recently, 20 men are now employed in the mine and at the mill.——The Shoo Fly mines, which are situated on the divide between Wallace and Moose creeks, will be worked during the present winter under the management of J. B. Hastings. A shaft will be sunk, and other development done.——The dredge on Kirtley creek is working full time, and will continue so through the winter.

Leesburg, November 10.

Shoshone County (Coeur d'Alene)

Forty claims in the Beaver Creek district, nine miles northeast of Wallace, near the Interstate-Callahan, Ray Jefferson, Rex, and others, are to be developed by the Red Monarch Consolidated Mining Co., incorporated by Conrad Wolfle of Spokane, with a capital of $2,000,000 in $1 shares. Two adits are being driven, one to be 1000 and the other 4000 ft. long, while 8000 ft. of diamond-drilling is to be done. A 14-drill compressor has been ordered. Bunk and boarding-houses are being erected. R. H. Hewer is superintendent.

The National Copper Co.'s 500-ton mill resumed work on November 11. About 10,000 tons of ore is broken in stopes and in storage-bins.

Under the management of A. A. Dunphy, the Coeur d'Alene Antimony Co.'s Old Antimony mine, at the mouth of Pine creek, is the scene of considerable work. A mill is under construction, the process embodying jigs, tables, and flotation. The product will contain 50% antimony. One shipment of hand-jigged material assayed 38% metal, returning $1500 net.

MICHIGAN

The Copper Country

Men are plentiful in the district, none of the companies sending outside for help, but there are no unemployed. The miners, trammers, and mill men were never more efficient.

Rail connection has been made to the White Pine mine, and a large reduction in costs will result, especially in the carriage of fuel and mineral.

No. 3 test of the New Arcadian ore is underway at the Franklin mill.

MISSOURI

Jasper County

A 150-ton mill, driven by gas-engines, is to be erected in 50 days by the United Iron Works Co. for the Grand Tower Mining Co. Ore occurs in hard ground between 66 and 96 feet.

A 300-ton electrically-driven mill is being constructed for the Ben Franklin Mining Co. by the Webb City-Carterville Foundry Co. Operation is expected to commence in 60 days.

The sixth annual drilling contest of the Hercules Powder Co. was held at Joplin on November 7. A large crowd attended. The first prize of $100 and gold trophy hammer was won by B. Anderson, of the Steers & Rice mine, and I. L. Seagraves of the Geneva mine, Webb City, who drilled 37$\frac{11}{16}$ in. in 15 minutes. This beat the winners of 1914 by $\frac{3}{16}$ in. Second prize, $50, went to F. McCoy and J. Gates of the Lockport mine, Galena, Kansas, making a 36$\frac{13}{16}$-in. hole. H. Haines and O. Lewis of the C. & S. mine, Webb City, were third with 29$\frac{7}{8}$ inches.

MONTANA

The total assessed valuation of this State is $439,785,819; to which the mining county of Silverbow contributes $42,419,-

268, followed by Cascade with $31,649,303; Lewis and Clark, $24,151,849, and Fergus, $20,910,585. Railroad valuation is nearly $80,000,000.

Silverbow County

In the suit of minority shareholders in the Alice Gold & Silver Co. *v.* the Anaconda company, the Court some time ago ordered a re-sale of the former's property to see if higher than $1,904,390 could be secured, the price that the Anaconda paid. On November 10 there were no bidders, so the property passes to the Anaconda.

The Butte & Columbia Copper Mining company has commenced driving a 5000-ft. tunnel which will connect the Butte side of the Rockies with the Jefferson county side. At 3000 ft. the depth will be 1500 feet.

NEVADA

Humboldt County

(Special Correspondence.)—The Buffalo Valley Gold Mining & Leasing Co. has been superceded by a new company (name not yet decided). J. A. McAllep, of Valmy, Nevada, will be superintendent, and John T. Reid, of Lovelock, manager. Building will be started at once of a 100-ton mill (gold), with entire new mining and milling equipment. Water will be piped to the mill. This property has been under development for three years.

Valmy, November 18.

The new mill of the Nevada Packard company is practically complete. About 7000 tons of ore is ready in the mine.

At a depth of 425 ft. in the Rochester Mines ground the east vein is 21 ft. wide. It has been opened on the 150, 220, and 300-ft. levels.

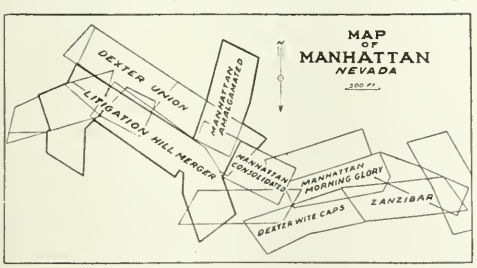
Rich ore continues to be extracted between 1200 and 1300 ft. in the Seven Troughs Coalition, and a four day's run of the mill last week yielded $8300. Exploration has been started at 1500 feet.

Mineral County

It is reported that bismuth ore has been discovered by W. R. Smith in the Cedar range, near the Copper Contact mine, and near Mina.

Nye County

The merger of the main mining properties on Litigation hill has been consummated, to be known as the Union Amalgamated Mining Co. Included in the merger is the Manhattan Milling & Ore Co.'s 10-stamp mill, cyanide-plant, and sampler. While the action of the directors of the various companies has to be ratified by the shareholders of the companies, there will be no difficulty in the obtaining of sufficient shares to vote in favor of the merger. All the large stockholders of the companies interested have already expressed themselves. The merger takes in the Manhattan Amalgamated Mining Co., comprising parts of three claims, the area of the claims being 23 acres free from conflict; the Litigation Hill Merger Mining Co., of parts of four claims, area 37 acres, and the Manhattan Earl Mining Co., area 14 acres. Three hoisting-plants, with orebins, transformers, surface track, ore-cars, etc., are already installed, and the electric mine pumps are at work draining the lower levels of the mine workings of each of the three properties. The main mining will be prosecuted through the Earl shaft, as it is 350 ft. deep, and connects with five levels. A summary of the ore produced by company and lessees shows the Earl to have produced 3948 tons, value $62,689, an average of $15.89 per ton; Litigation Hill Merger has produced 3918 tons, gross value $85,428, an average of $21.80 per ton; Manhattan Amalgamated has produced 1749 tons, gross value $35,731, an average of $20.43 per ton. An important orebody is already developed between the Earl and Amalgamated properties and from the 300-ft. level of the Earl proves to be from 4 to 8 ft. wide assaying $22.50 per ton. This orebody would have been the source of considerable apex litigation, if the present merger had not been consummated. A large quantity of medium-grade ore has been developed in the three properties by past lessees of the companies. This ore will average from $7 to $10 per ton, and although the lessees have been unable to mine and mill this grade ore at a profit; under company management, owning and operating its own mill, it will mean good profits over and above mine and mill costs.



THE CONSOLIDATED PROPERTIES ARE WITHIN THE DARK LINE.

At a directors' meeting of the White Caps Mining Co. held in Tonopah on October 27, definite action was taken toward the acquiring of the 10-stamp mill and cyanide-plant owned by the Associated Milling Co. The mill and all other assets of the milling company were purchased for 495,000 shares of White Caps treasury stock.

Last week the output of Tonopah mines was 9189 tons worth $191,362; lessees contributed 370 tons.

The Tonopah Mining property was inspected by directors, who are pleased with conditions generally. The mill treated 3100 tons of $12 ore last week.

At 1350 ft. in the Extension the ore-shoot has been opened for 450 ft., with no sign of the end, with great width and high value.

OKLAHOMA

Fifteen new concentrating plants will soon be increasing the output in the north Oklahoma zinc region if information recently gathered by the Miami *Record-Herald* is correct. A list of these plants with their nominal tonnage capacity follows:

Mills.	Tons.	Mills.	Tons.
Beaver	200	Picher	300
Blue Goose	200	Picher	300
Century	150	Picher	300
Croesus	200	Picher	500
Hannibal & St. Joe	150	Red Feather	200
Katy	250	Welch	200
Mission	400	White Eagle	200
Myrtle	200		
		Total	3750

This practically assumes a one-third increase in the production of concentrates in the Oklahoma field, as the present capacity per shift is reported at 6250, listed as follows:

Companies.	Tons.	Companies.	Tons.
Carson Mining Co.	400	Lost Trail M. Co.	250
Carson Mining Co.	200	McConnell-Barnes	200
Concentrating Co.	150	McConnell Zinc Mines	450
Cornfield L. & Z. Co.	250	Midas L. & Z. Co.	150
Cactus Mining Co.	250	Miami L. & Z. Co.	400
Denver-Miami M. Co.	200	Miami Amalgamated	250
Emma Gordon	400	Mizpah M. Co.	250
Eureka Mining Co.	150	Never Sweat M. Co.	200
First Chance M. Co.	100	Old Chief	150
Golden Hen M. Co.	150	Prairie M. Co.	250
High Five M. Co. (tailing mill)	200	Quapaw M. Co.	250
Kansas Mining Co.	50	Queen City-Joplin	200
Kansas Tailing	50	Turkey Fat M. Co.	250
Lennan L. & Z. Co.	300	Vantage M. Co.	150
		Total	6250

OREGON

The U. S. Geological Survey has just published its mines report on gold, silver, copper, lead, and zinc in Oregon in 1914, by Charles G. Yale, who states that there was a material decrease in the number of producing mines, namely 68. Everything showed a decrease, as follows, the figures for 1913 being in parentheses: mines producing, 105 (173); ore extracted, 124,331 tons (155,901); gold, $1,591,461 ($1,627,710); silver, 142,552 oz. (179,036); copper, 39,248 lb. (43,330); lead, 16,436 lb. (87,207); and total value, $1,676,153 ($1,746,402). Deep mines yielded 50,388 oz. gold, and placers 26,525 oz. Hydraulic,

MAP OF OREGON.

drift, and surface and dredge work produced $178,899, $4426, and $364,992 respectively. Amalgamation at quartz mines recovered $333,768 and cyanidation, $594,861. Baker county produced most of the gold from mines and placers.

Baker County

The Mother Lode properties in the Cracker district have been examined by J. A. King of the Tonopah Belmont company, Nevada. If satisfactory, the report will result in a consolidation of the North Pole, Eureka, Excelsior, Taber fraction, Columbia, and Golconda. It will be the largest deal ever consummated in Oregon. The North Pole mill is working satisfactorily.

SOUTH DAKOTA

Lawrence County

Prospecting in the Two Bit district is being actively carried on with little publicity, and results are encouraging.

Pennington County

Renewed activity is reported from the old Tigerville district, near the Burlington railroad's Redfern station. The King Solomon shaft will be unwatered and the mine examined. Other properties nearby are the Slogan and Bullion.

TEXAS

Brewster County

(Special Correspondence.)—Development of quicksilver properties in the Terlingua district is stimulated by high prices for the metal. The Chisos Mining Co. is the principal operator and producer. The Study Butte company is extracting high-grade ore. The claims of W. P. Gaines and others of Austin contain deposits of cinnabar, and a sale to Philadelphia people is likely.

Terlingua, November 5.

Live Oak County

(Special Correspondence.)—Following a preliminary examination of the potash deposits in this district, the U. S. Geological Survey has sent in equipment to explore the material underground, in charge of S. H. Walker. The State University is also to survey the so-called bad lake region of Lynn county, where potash is thought to occur.

Simmons, November 5.

UTAH

Boxelder County

The Lakeview Mining Co. at Promontory Point has declared its fifth dividend, of 2½c. per share, equal to $11,250. Another company is to commence work in this area.

Juab County

On November 26 the May Day company will pay 3c. per share, equal to $24,000. Lessees are also doing well.

Salt Lake County

At Lark the Ohio Copper Co. is to erect a 25-ton Field's flotation-plant, similar to that installed at the Royal Basin mine, Maxville, Montana. There is a large quantity of tailing also worth treating at Lark.

Summit County

The Snake Creek tunnel was advanced 312 ft. in October, the face now being in 13,025 ft. The flow of water is larger.

The strike at the Silver King Coalition mine has been called off.

It is reported that an adit 14,000 ft. long may be driven to develop the western ground of the Silver King Consolidated. A site for the portal and mill will probably be on Three Kings ground.

WASHINGTON

Ferry County

The Knob Hill Mining Co., which owns and is operating the Knob Hill and Mud Lake mines at Republic, has purchased the Alpine claim, adjoining the Knob Hill on the east, at a reported price of $20,000, according to information received in Spokane. The initial payment of $5000 was made on October 25, and the remainder is to be paid in $5000 installments at 12 months' intervals, with deferred interest at 5%. The Alpine claim was owned by Jonathan Bourne of Portland, from whom the Knob Hill company acquired the Knob Hill and the Mud Lake. "Engineers who were employed by the Knob Hill company to examine the Alpine ground, state that acquisition of the property enhances the value of the consolidated holdings not less than 35%," states John G. LaRue, who made the announcement of the deal.

Spokane County

The Spokane Stock Exchange has decided to establish a mines publicity bureau, to distribute news concerning mines in the region contiguous to Spokane.

Stevens County

At the Northport smelter there are 240 men employed in reconstruction. Foundations, three-mile flume, reservoirs, and other work are making good progress. The Electric Point mine, 26 miles away, is producing rich lead-silver ore, and will send it to the new smelter when complete.

WISCONSIN

LaFayette County

(Special Correspondence.)—At Benton the Frontier Mining Co. is building a new surface plant on the Treganza.——Another new plant is proposed for the Hird mine. This company has paid $200,000 in dividends during the past six years.——The Longhenry Mining Co. is installing new equipment.——Misabi type pumps have been installed at the Kittoe mine: 1700 gal. is lifted 200 ft. per minute.——Two new separator-plants are working successfully.——Four miles of macadam road is being built to connect all outlying producers.

The United States Steel Corporation is operating in the Shullsburg district, and is rushing a new mine plant to completion.——The Winskill mine is producing heavily.

At New Diggings the Vinegar Hill Zinc Co. is building a

new power-plant and mill on the Blackstone lease recently drilled. The Wisconsin Zinc Co. will start a new $75,000 electro-static separating-plant on the 20th.——The Champion mine is producing 400 tons of ore per week.——W. W. Seaver of Pocatello has acquired the Booty lease, and will drill it at once.——The Crawhall mine, once a famous dividend-payer, is worked out and will be abandoned.

Benton, November 10.

WYOMING

Bighorn County

The great gas-well at Byron has been capped. There is great excitement and much activity in Elk basin, near the Montana and Wyoming line, as oil has been discovered recently. Drilling rigs are being rushed in, and people are flocking for locations. Two or three wells have been brought in already and the field promises to be an exceptionally good one.

CANADA

British Columbia

It is stated that all mines in this province are producing about 11,000 tons of ore daily, over 4000 tons coming from the Boundary district, and over 3000 from the coast. The completion of works now under way is expected to make possible an increase in the daily tonnage of the province to 20,000.

The Jewel-Denero property near Greenwood has been leased.

A new $60,000 bridge was completed last week for the Great Northern line over the North Fork canyon to the Granby smelter at Grand Forks. A year ago the Canadian Pacific also erected a bridge, costing $100,000.

Ontario

In part of the town of Cobalt the Coniagas company has three drills under the Hunter block and under Argentite street on exploration, and six stoping and on development. The new canvas-plant is treating up to 80 tons of slime per day from the concentrating-plant, making a 130 to 150-oz. product. A cyanide-plant to treat this material will soon be ready. About 120 men are employed.

The deepest shaft at Cobalt is at the Beaver mine, it being 1228 ft., with sinking still in progress until the diabase is reached. Development is under way at 300, 400, 460, 530, and 600 ft. There are 130 men employed. While silver is low no attempt is made to produce much ore.

During October the Nipissing high and low-grade mills treated 87 and 7272 tons of ore respectively, yielding $177,183. The refinery shipped 486,901 oz. silver, some being from custom work. The Cobalt Lake fault-vein is to be explored in Nipissing ground. Prospecting by hydraulicking continues.

The Canadian Copper Co. has taken an option on a copper claim owned by Smith and Durkee of Sudbury, located in Connaught township, east of the West Shining Tree gold area.

The demand for molybdenite for steel hardening in England has encouraged its production in Canada. The Orillia Molybdenum Co. of Orillia, Ontario, is now treating molybdenum ore, and last week made its first shipment of concentrate to the British war office. Consignments will be forwarded weekly.

MEXICO

Hidalgo

From the treatment of 16,535 tons of ore in September the Santa Gertrudis profit was $39,000.

Sonora

Owing to the Villa activity in this State, exports of minerals to Arizona decreased during October. The total was 134 cars, containing 4689 tons, of which 4160 tons was from the Moctezuma at Nacozari and 131 tons from El Tigre, the latter shipping 55 bars of bullion. The value of exports was copper ₱722,000; silver, ₱293,000; and gold, ₱186,000, a total of ₱1,201,000.

PERSONAL

H. H. Webb has gone to New York.

Arthur Winslow is here from Boston.

Ben. S. Revett has returned to Denver.

S. A. Worcester is at Ouray, Colorado.

L. D. Ricketts was here during the week.

J. W. Malcolmson is at Douglas, Arizona.

J. H. Mackenzie has returned from Juneau.

R. Gilman Brown has returned to London from Siberia.

Walter G. Perkins is on a visit to New York, from London.

R. T. Mishler, metallurgist to the El Tigre, Mexico, is here.

Thos. B. Stearns, of Denver, has been visiting the Exposition.

J. Power Hutchins has returned from the Altai to Petrograd.

Leo Von Rosenberg was in the Ray district, Arizona, last week.

Jack Reid, of Good Springs, Nevada, has been visiting the Exposition.

Charles A. Banks has gone from Greenwood, B. C., to Edinburgh, Scotland.

A. D. Hughes has returned to San Francisco for the winter, from Atlin, B. C.

Robert H. Bedford has returned to Grass Valley from a visit to Douglas, Arizona.

G. A. Joslin has been appointed engineer with the Ray Consolidated, in Arizona.

J. Parke Channing was here this week and is now on his way back to New York.

Jesse J. MacDonald is the representative of the Pacific Mines Corporation at the United Verde Copper Co.'s smelter, at Clarkdale, Arizona.

George B. Holderer, who recently returned from South America, has been appointed general manager for the Furlough Development Co., which is developing a copper property near Wickenburg, Arizona.

Alberto E. Blair, manager for the Madero estates in Mexico, was ordered to leave Torreon by the Carranza authorities on the ground that the Madero family, with the exception of Julio Madero, had supported Villa. He refused and appealed to the British embassy at Washington.

Schools and Societies

The second session of the Prospectors' Short Course at the Mackay School of Mines of the University of Nevada, will be held from January 30 to February 26, 1916. The work of the course will include both lectures and laboratory exercises, and the subjects taken up will be prospecting, assaying, mineralogy, geology, prime movers, chemistry, hygiene, sanitation, first aid to the injured, and mining law. In addition to these regular courses there will be a number of special lectures upon subjects of interest to the prospector.

The ordinary general meeting of the Chemical, Metallurgical and Mining Society of South Africa was held at Johannesburg on September 18. Papers were read as follows: 'An Improved Method of Removing Broken Ore from Stopes,' by M. Weinbren; discussion on notes previously read; 'Cyanide Consumption on the Witwatersraud,' by H. A. White; 'The Prevention of Hydrolysis in Cyanide Solutions,' by H. M. Leslie; reply to discussion: 'Safety Measures in the Use of Explosives,' by William Cullen; 'The Use of Scoop Discharges in Tube-Mills,' by W. R. Dowling; 'Notes on the Practical Testing of Working Cyanide Solutions,' by Edward H. Croghan; continued discussion: 'Notes on the Treatment of Antimonial Gold Ores from the Murchison (Transvaal) Range,' by H. R. Adam; 'Recent Investigations on Dust in Mine Air and the Causation of Miners' Phthisis,' by James Moir.

THE METAL MARKET

METAL PRICES.

San Francisco, November 18.

	Cents per pound.
Antimony	37
Electrolytic copper	19
Pig lead	5.50—5.70
Quicksilver (per flask)	$100
Spelter	17
Zinc-dust, 100-kg. zinc-lined cases	25

ORE PRICES

Antimony: 50 and 60% products, per unit.....$1.60 and $2
Magnesite: calcined, per ton $30
Manganese, 50% metal, 8% silica, per ton..... 12
Molybdenite: 90% MoS_2, per pound..... 1.50
Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot.....$35—40

New York quotes $41 per unit for 60% tungsten ore, prompt delivery, first half 1916, $38; for antimony ore, $2.25 per unit for prompt from South America; for manganese ore (Brazilian) 46 to 50c. per unit; and 96c. to $1 per pound for vanadium oxide, 80%.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, November 18.—A large business is being done in copper, resulting in a strong upward movement; lead is strong, with large export sales; the zinc market is excited, heavy inquiries are reported.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov. 11	50.25	Oct. 6	49.64
" 12	50.25	" 13	49.55
" 13	50.25	" 20	49.53
" 14 Sunday		" 27	48.91
" 15	50.37	Nov. 3	49.37
" 16	50.62	" 10	50.02
" 17	51.00	" 17	50.46

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

The above steady increase in price indicates a firm market with something behind it.

Exports of silver to India and China to October 27 total £3,400,250 against £4,721,500 in that period of 1914, a decrease of say 14,000,000 oz. Stocks in London are about 14,000,000 oz. Trouble in the Mediterranean Sea and Suez Canal may hold-up shipments to the Orient. Good reports have been received in London concerning the weather in India, a factor in the silver market, especially in the Gujurat district. The position of India in silver is considered remarkable at present, as stocks have increased in spite of few new imports of metal of late.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Nov. 11	18.25	Oct. 6	18.00
" 12	18.37	" 13	18.00
" 13	18.50	" 20	17.87
" 14 Sunday		" 27	17.79
" 15	18.62	Nov. 3	17.89
" 16	18.87	" 10	18.08
" 17	18.87	" 17	18.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during last week of October amounted to 13,657,586 lb., valued at $2,335,542. To England went 1,301,411; France, 5,551,235; Italy, 1,121,329; Russia, 2,912,813; and Sweden, 1,996,644 lb. Imports totaled 9,322,712 lb., worth $1,161,664. Canada sent 2,377,642; Chile, 718,351; and Peru, 5,932,868 pounds.

A strike has shut-down the Nichols Copper Co.'s Laurel Hill refinery, which has an output of 1,000,000 lb. per day.

Recent returns are as follows: Braden, October, 3,726,000 lb.; Arizona Copper, September, 1,552,000 lb., against 3,600,000 lb. in August, due to the strike; Miami, October, 4,025,958 lb.; and Old Dominion, 2,970,000 lb. in October.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Nov. 11	16.25	Oct. 6	14.37
" 12	16.50	" 13	13.55
" 13	16.75	" 20	13.37
" 14 Sunday		" 27	14.12
" 15	17.25	Nov. 3	14.92
" 16	17.37	" 10	15.62
" 17	18.00	" 17	17.02

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The English supply is said to be practically cornered, as the Government has first call on stocks, now low.

In October the Butte & Superior produced 15,000,000 pounds.

Up to $110 per ton was paid for 60% zinc product at Joplin last week, when the output was 5807 tons blende, 208 tons calamine, and 815 tons lead, averaging $96.47, $47.83, and $59.63 respectively, with a total value of $624,046.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov. 11	5.15	Oct. 6	4.50
" 12	5.15	" 13	4.50
" 13	5.15	" 20	4.50
" 14 Sunday		" 27	4.75
" 15	5.25	Nov. 3	4.87
" 16	5.25	" 10	5.02
" 17	5.25	" 17	5.20

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Date.	Week ending	Nov. 4	97.50
Oct. 20	92.00	" 11	100.00
" 27	93.00	" 17	100.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is firm at 42.50 to 43.50 cents.

ANTIMONY

Chinese and Japanese are quoted at 36 to 36.50c., duty paid. Offering of December shipments from the Far East have been made at 32c. c.i.f., about equal to 35c.

ALUMINUM

Quotations for No. 1, 99% pure are nominal at 56 to 58c.

Eastern Metal Market

New York, November 12.

The activity referred to a week ago has continued; a good volume of business was done in the leading metals, and prices of all have mounted to higher levels. Millions of pounds of Lake and electrolytic copper have been sold, and the Lake producers are in a particularly good position. Zinc has advanced steadily, and carried with it the price of sheet-zinc. Lead was advanced $5 per ton within the week, and consumers bought on the rise. Tin advanced sharply because of a shortage in the supply, and fear that deliveries may be halted by the submarine warfare in the Mediterranean. Antimony is quiet, but firm at its high level. The nominal price of high-grade aluminum is 56 to 58c. per pound.

Big deals to merge iron and steel companies, and even to secure control of machine-tool plants, continues to absorb much attention from investors. How busy the steel industry is at present is indicated by the fact that the United States Steel Corporation's unfilled orders increased 847,000 tons during October. The increase breaks all records. The prices of finished and semi-finished steel are advancing on every side; in fact, the question today is more one of getting deliveries than what price shall be paid. The value of iron and steel exports, including machinery, was $38,400,000 in September, against $37,727,000 in August. Large shipments of railway equipment and other machinery are in transit to Vladivostock, to say nothing of enormous quantities sent to Europe. The Pittsburg base for plates, shapes, and bars is 1.60c., but premiums of $1 and $2 per ton are easily obtainable.

COPPER

Up to the end of last week a heavy business was done for export, while domestic consumers having war contracts took good-sized quantities as well. Most of the buying was at 18c., New York, or near that figure, and both electrolytic and Lake were taken, with the latter getting what ordinarily would be considered more than its share. One Lake producer sold in one month more than he can produce in four months. As one result of the recent activity, Lake promises to again be held at a premium, though not a large one. At the end of the week electrolytic was advanced to 18.12½c. cash, New York, and Lake to 18.25c., cash. Second-hands did not cut much of a figure in the movement, either because they did not have the metal, or were holding for higher prices. This week the market has been strong, but there has not been much doing. The copper sold for export was taken by England, France, and Sweden, the latter country taking several hundred tons. The action of the producers in booking orders for probably 60,000,000 lb. without letting the market run away with a too rapid advance in prices, which would at least have temporarily put a quietus on activity, is commended by the trade generally, as all interests fare better on such sane procedure. Choice Lake copper is quoted at 18.37½ to 18.50c., cash, and one producer is sold up to next June. Mention of high-grade copper recalls a story that is going the rounds of a fuse and shell contractor, who some months ago gave an order for 1,000,000 lb. of 'copper.' When delivery was made, the mill that was to work up the metal, refused to accept it because of its inferior grade. Through the medium of a broker the entire shipment was thrown on the market, and sold to several consumers. But the end is not yet, for the producer only agreed, at the price involved, to deliver the metal to one point in the Naugatuck valley. The original buyer has war contracts running into many millions. The London market for electrolytic has been extremely strong, and on November 11 was quoted at £91, compared with £88 not many days ago. Spot standard on that day was quoted at £75 10s., making a difference of about £16. Exports from 1st to 12th totaled 4588 tons.

ZINC

Steadily increasing strength has marked this metal and with the advancing prices a large business has been done between 15 and 16c., New York, for prompt and nearby. Both foreign and domestic buyers have taken zinc, the latter buying extensively into the first quarter of 1916 at prices ranging from 14.75 to 15c., New York. The St. Louis quotation for first half delivery is from 13.50c., St. Louis, or 13.75c., New York, to 14c. With the quotation for prompt at 16c., it looks as though sellers are trying to stimulate the buying of futures. Horsehead spelter has been sold well into next year at 40c. Extra refined prime Western spelter has been freely offered as a substitute for the naturally choice grades at from 25 to 28c. per lb., but not all of the consuming trade take kindly to it, which may be due to the prejudice which invariably plays its part where consumers get used to certain grades or brands. What with the steadily advancing prices for steel, and the higher price of spelter, makers of galvanized sheets will be confronted with the necessity of making further advances in the quotations for their product. They now quote No. 28 galvanized sheets at 3.80 to 3.90c. The exports of spelter continue at an excellent rate, those of the month up to November 12 totaling 1163 tons. From abroad it is reported that shipments from this country have been delayed, and that some September contracts are still unfilled. Spelter advanced £8 per ton in London, November 11, making the quotation £85 10s., equal to over 16c., New York, discounting freight and insurance. The base price of sheet-zinc, carload lots, f.o.b. mill, was advanced on November 4 to 16.50c., and again on the 9th to 17c.

LEAD

The A. S. & R. Co. advanced its New York quotation $2 per ton, or to 5c. per lb., on November 4, and on the 10th announced a further advance of $3 per ton, making the price 5.15c. per lb., New York. St. Louis quotations were 10 points below these prices. The first advance, like the previous one to 4.90c., New York, surprised the trade, but had the effect of stimulating buyers, and created activity on both foreign and domestic account. Before the upward trend was inaugurated, the market looked weak, and independents were cutting prices to get business. They continued this policy to a less extent after 5c. was reached, and ceased when the market went to 5.15c. All interests are well sold up. Two theories are put forth to account for the advance, one being that the leading interest has booked large export orders, and the other that the seizure by Villa of certain plants in Mexico may curtail the English supply. London is firm and advancing.

TIN

For some time there has been developing a scarcity in spot tin, and under this influence prices have advanced, the quotation on November 10 reaching 37c. The activity of submarines in the Mediterranean and the loss of several vessels there has caused uneasiness, also unconfirmed news that the Suez Canal was to be closed for military reasons on November 11 sent the spot quotation up to 43c. In warehouses there are considerable quantities of tin, but apparently these are owned by consumers. Banca tin is now selling in this market at from ⅛ to ¼c. under Straits. Makers of tin-plate have been fairly good purchasers of futures in the past few days, but on the whole the market has been quiet, and business has been done by a few hands only. Good round lots of spot are almost impossible to obtain. The arrivals up to November 12 totaled 975 tons, and there was afloat on that day 4703 tons, not all of which will arrive this month. Arrivals at Pacific ports in September were 71,847 lb. at San Francisco, valued at $21,624, and 939,942 lb. at Seattle, valued at $324,354.

COMPANY REPORTS

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO.

For the third quarter of 1915 the Granby Consolidated reports as follows:

Ore treated, tons	521,252
Copper, pounds	12,057,385
Gold, ounces	14,849
Silver, ounces	177,610
Cost at Anyox and Grand Forks, cents per lb.	7.939 and 10.91
Gross income (including 8,385,100 lb. at 15.5c. unsold)	$2,310,262
Profit	486,436
Dividends	224,978
Surplus (bond interest deducted)	206,210

CHINO COPPER CO.

The third quarter of this New Mexican property resulted as follows:

Overburden removed, cubic yards	841,055
Ore treated, tons	690,400
Average copper-content, per cent	1.98
Extraction, per cent	67.82
Metal output, pounds	18,545,638
Cost, cents per pound	7.18
Profit	$1,555,414
Dividends	652,455
Surplus	902,959

An average of 16.003c. per lb. was received for copper, against 17.54c. in the previous quarter, resulting in less profit. Costs were higher due to a lower grade ore. Recovery was higher.

NEVADA CONSOLIDATED COPPER CO.

The report of this company for the September quarter has the following:

Overburden moved, cubic yards	866,713
Ore treated, tons	837,374
Average copper-content, per cent	1.66
Metal output, pounds	18,516,121
Cost, cents per pound	8.01
Profit	$1,590,621
Dividend	749,796
Surplus after depreciation and ore extinguishment	612,352
Total surplus ($243,937 cash)	3,335,040

Profits were $226,528 greater than in the preceding quarter.

The average price of metal was 15.876c. per lb. Of the ore treated 98% was from steam-shovel work. The Ruth mine is ready for active production of ore.

UTAH COPPER CO.

The Utah Copper Co. reports as follows for the third quarter of 1915:

Capping removed, cubic yards	1,617,779
Ore treated, tons	2,498,400
Average copper content, per cent	1.4089
Extraction, per cent	63.59
Metal output, pounds	44,766,841
Net cost, cents per pound	7.64
Net profit from mine	$3,663,708
Net profit from all sources	4,414,564
Dividends	1,624,490
Surplus	2,790,074

The amount of overburden removed was an increase, and the quantity treated was 283,241 tons greater; the output was about 4,000,000 lb. more, but profits were almost the same. Business on the Bingham & Garfield railroad was good.

RAY CONSOLIDATED COPPER CO.

The third quarter of this Arizona company showed as follows:

Underground development, feet	12,205
Ore mined and treated, tons	716,211
Cost of mining and coarse crushing, cents per ton	70.835
Average copper content, per cent	1.659
Cost of treatment, cents per ton	56.54
Metal from mill and crude ore smelted, pounds	15,382,354
Price received, cents per pound	15.709
Cost, cents per pound	10.199
Net profit	$781,272
Dividends	547,801
Surplus	$233,471

The profit was $564,961 less than in the previous quarter, while the output was somewhat higher; but a lower price for copper, alterations to plant, and labor troubles all helped to lower the profit.

CONSOLIDATED INTERSTATE-CALLAHAN MINES CO.

The report for the third quarter of this great Idaho zinc mine contains the following:

Ore treated, tons	29,021
Crude ore shipped (40.68% lead, 19.54 oz. silver) tons	203
Crude ore shipped (49.01% zinc) tons	2,506
Concentrate shipped (53.33% lead, 23.86 oz. silver) tons	792
Concentrate shipped (48.06% zinc) tons	11,942
Extraction of zinc, per cent	84
Cost of mining, per ton	$3.389
Cost of treatment, per ton	$1.082
Cost of shipping, per ton	$1.190
Total	$5.661
Net profit	$863,192
Dividends, two of $2.50 per share	$1,162,375
Surplus	$795,679

All additions and improvements to the mill are finished. The aerial tram is saving $5500 per month. Cottages were built, also a rooming-house for 200 men, while a boarding-house is under construction.

TOMBOY GOLD MINES CO., LTD.

The report of this Colorado property covers the year ended June 30, 1915, and that of D. A. Herron, general manager, contains the following information:

Work in the Argentine mine totaled 427 ft., of which 133 ft. was between the 1900 and 2100-ft. levels, the remainder at 2200 ft. The drifts were extended as far as ore was considered profitable, and contained $2 to $3 in gold and silver, and 2 to 4% lead. All stopes above 500 ft. have been drawn, and all available pillars supporting that level removed. Ore reserves in the Argentine are 185,000 tons, of which 135,000 tons is broken in stopes. In the Montana mine development covered 5936 ft. After considerable trouble ventilation was improved. The 1150-ft. level was extended nearly 2000 ft. The Fortuna, 1450 ft., 1600 ft., and Ophir levels made good progress northward, also at 1900 ft. While not as good as last year, results are encouraging. Reserves are 350,000 tons, 200,000 tons being broken in stopes. A snow-slide held up the aerial tram for 96 hours.

The 60-stamp mill and concentrator operated satisfactorily, but improvements had to be made to the cyanide-plant. The revenue from mill bullion, cyanide bullion, and concentrates from 145,857 tons of ore, was $7.05 per ton, at a cost of $4.49 per ton.

Total revenue was $1,050,870, of which $396,223 was profit. With the balance of $230,000, there was available $626,223, of

which $226,000 was paid in dividends. After allowing for depreciation, income-tax, etc., the balance was $110,000.

BROKEN HILL PROPRIETARY CO., LTD.

The report of this well known Australian company for the half-year ended May 31, 1915, is interesting on account of the variety of contents, namely, mine operations, concentration, smelting, and the new steel plant, the last mentioned being recently commenced at a cost of about $6,240,000.

The mine produced 109,911 tons of ore. The crude-ore mill treated 90,248 tons of crude ore and 11,449 tons of dump-tailing; and the re-grinding plant 82,140 tons of dump-tailing and 1712 tons of jig-tailing, producing a total of 17,900 tons of lead-silver concentrate. The flotation-plant treated 139,763 tons, yielding 33,318 tons of concentrate assaying 46.95% zinc, 12.48% lead, and 6.26 oz. silver. The sulphuric acid plant produced 1826 tons of strong acid.

The Ropp roasting-furnaces and Dwight-Lloyd plant treated 42,752 and 52,408 tons of concentrate, etc., respectively. The smelter at Port Pirie reduced 124,424 tons of mixed material, yielding 59,742 tons lead bullion. The lead refinery produced 46,168 tons lead, 362 tons antimonial-lead, and 1,912,205 oz. silver. The spelter plant yielded 2471 tons spelter and 381 tons blue powder.

Revenue from metals, custom smelting, iron and steel sales, etc., totaled £881,150, of which £272,279 was gross profit. Depreciation, various offices and agencies, funds, taxes, etc., totaled £93,438. Two dividends, No. 169 and 170, absorbed £118,100. The surplus is £1,062,809, including £165,624 cash.

Good orders have been received for iron and steel products, work being assured for a year ahead. The report is replete with plans, photographs, and other information.

JUMBO EXTENSION MINING CO.

The report of the Jumbo Extension Mining Co., Goldfield, Nevada, for the third quarter of 1915, shows a production of 8577 wet tons of ore, having an average assay-value of $39.53 per ton, according to mine sample. This ore was mined at a cost of $23,340 or $2.72 per ton. All this ore was produced from the Velvet claim and shipped to the Western Ore Purchasing Co. A total of 1782 ft. of development work was performed from No. 1 shaft, at a cost of $12,416, or $6.97 per ft. No. 2 shaft was lowered 301 ft., at a cost of $9826, or $32.65 per ft. The total cost of mining, development, and repairs, which includes overhead and administrative charges, is $4.37 per ton of ore produced.

Following is a summary of receipts and disbursements for the period ended September 30:

Revenue.		
Smelting ore sold		$325,041
Freight and treatment	$73,275	
Sampling	5,406	
Smelting losses	37,721	116,402
Net returns from ore sold		$208,639
Costs.		
Mining	$23,340	
Development	12,416	
Repairs	1,766	
Velvet shaft	9,826	47,348
Net realization from operation		$161,291

A plan is now being considered by the company to form a subsidiary company on the Diamondfield portion of its property to work the ground on an independent basis. It is not contemplated to use any funds derived from operations on the Poloverda or Velvet claims, but to place the junior company on its own merits. Final plans will be announced later. The new company will have the same management as the Jumbo Extension.

BOOK REVIEWS

How to Make Low-Pressure Transformers. Second Edition. By F. E. Austin, Hanover, New Hampshire. For sale by the Mining and Scientific Press. Price, 40 cents.

This little book is a companion to the author's work on the design, etc., of high-pressure transformers, and from it amateurs and others will be able to construct their own apparatus. Transformers appear to be complicated to the layman, and here is everything easily explained.

Design of Steel Bridges. By F. C. Kunz. P. 461. Index, and appendix with 52 plates. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $5.

The author states that this volume is to be the first of four on different branches of structural engineering. It is a practical text-book dealing with the design of the different types of steel bridges most commonly used. The first chapter considers the several forces acting upon a bridge truss, following which the determination of stresses in the different parts of a bridge is discussed. Then comes the design of the various parts of a simple truss bridge from the floor system up. The calculation of stresses and the design of viaducts, elevated railroads, and movable bridges are then taken up in order. Under arch bridges, the two-hinged and three-hinged, but not the hingeless, arches are considered. Cantilever bridges are then discussed, but suspension bridges are not considered in detail. The appendix contains data on the bearing pressure for foundations, specifications, and similar matter. There are a large number of tables and diagrams illustrating the text, and the plates give examples of accepted practice in the various branches of bridge design. While lack of attention to details is shown by such statements as that on page 215, that the length of spiral is always 720 times the super-elevation, and the one on page 368 placing the Columbia river in California, the book in general will prove of considerable value to the bridge engineer and the student.

The Elasticity and Resistance of the Materials of Engineering. By William H. Burr. P. 919. Ill., index. John Wiley & Sons, Inc., New York. For sale by the Mining and Scientific Press. Price, $5.50.

This is the seventh edition of this valuable treatise, which appeared first in 1883. Much new material has been added since the last edition and a large part of the book has been re-written. In particular, the section on reinforced concrete is almost entirely new, the design of columns and beams of this material being taken up in considerable detail. The first two chapters of the book are devoted to the general theory of elasticity and of flexure, including a discussion of shearing stresses. Torsion is then considered and the resistance of various materials when subjected to this form of stress is given. The next chapter considers the strength of hollow cylinders and spheres. Then come discussions of resilience and of combined stresses. The second part of the book takes up the properties of the various materials of engineering with reference to both tension and compression. Riveted joints and pin-connections are next considered. The treatment of long columns of various materials is thorough. Beams and plate-girders are next considered. Stressses in various miscellaneous articles such as hooks, springs, rollers, spikes, etc., are then discussed. Two chapters are devoted to the fatigue of metals and to the flow of solid bodies under stress. The principal appendix contains a theoretical discussion of elasticity.

NEW MACHINES AND DEVICES

Information based on letters and catalogues from manufacturers.

Air-Feed Hammer-Drill for Driving

By FREDERICK W. COPELAND

This machine may be summarized as follows:

A light, rotating hammer-drill, with water-jet attachment, mounted on a pneumatic-feed cylinder, with offset arm to be clamped in an ordinary trunnion, and mounted on a column arm or tripod. It is intended for driving, and in this work saves time and labor as the air-feed of the stoping hammer-drill does in drilling upper holes. The drill may be removed from its mounting, and used either as a stoper or as a hand-sinker, or block-hole drill. A close approach is thus made to the ideal, one-man, universal drilling machine.

The ambition of modern designers has been to develop a practical driving machine, operated by air-feed. As is well known, the elimination of the shell and feed-screw form of mounting in the modern stoping-drill, and the substitution of the air-feed cylinder and piston, resulted in a great increase in drilling speed in all upper hole work. Air-feed stopers, in spite of the fact that a striking plug or anvil is employed, secure high speed, because of the fact that the air-feed holds the bit constantly against the rock, so that any break in its character is followed instantaneously by the steady push of the air. In the case of the screw-feed, the operator must catch the sound of the hammer, (providing he is operating a hammer type of drill) as it strikes the front-head; and take up the slack with the crank before the drill can work again at full load.

Effort has been made by means of what is known as the 'reverse-feed' cylinder to adapt the stoping-drill to driving work. This has been only partly successful, being useful mainly as a temporary expedient in work of short duration or in development. One difficulty encountered was the fact that the rate of feed cannot be varied, as it can with the feed-screw machine; if the cutting is soft or uneven, a stoper will drive forward as the resistance decreases and bind the bit. This necessitates freeing the steel by hand, with loss of time and effort on the part of the runner. If the reverse-feed stoper is fitted with an extra light feed, to handle soft cutting in ore, no impression will be made when hard rock is encountered. Another objection is that the length of the stoper, when arranged for driving, makes it clumsy to operate in cramped quarters and difficult to dip for cut holes, as the long feed-cylinder strikes the roof.

The problem of eliminating the feed-screw and crank, with its attendant reduction in drilling speed, loss of time in moving, changing steel, etc., is claimed to have been solved, and the result embodied by the Sullivan Machinery Co. in a new type of mounting for its automatically-rotating, hand-feed hammer-drill. The idea for this mounting came from southeast Missouri, where a home-made appliance, for mounting hammer-drills for driving in disseminated lead ore formation, showed promise. The perfected mounting consists of a feed-cylinder and piston, similar to the reverse-feed type employed for mounting stopers. Instead of one port leading to the back end of the cylinder, to drive the feed piston, and with it, the drill, forward against the work, there are two ports in the piston-rod, one-conducting the air to the rear end of the feed-cylinder, and one to a point just forward of the feed-piston. By this means, an advantage is secured, namely, the drill is not only advanced to its work by air power, but is withdrawn from it by the same means. As desired, air can be admitted to the rear of the feed-cylinder only, to carry the drill forward against its work; to the front end of the cylinder only, to carry the drill and steel back from its work; or to both sides of the feed-piston at once, in which case a forward feed of modified strength is secured. Thus the feed may be regulated to suit the character of the ground being drilled, and when starting a hole, crossing a slip, or cutting through a vug or soft place, the operator can so manipulate the action of the drill as to prevent its becoming stuck, and use just the right kind of blow. These changes of operation are controlled by a common throttle-valve which admits air to both ports of the feed, and to the drill as required. The runner does not have

THE NEW AIR-FEED HAMMER-DRILL.

to stand behind his machine in order to operate it, but can stand in front, with both hands directing the steel after the throttle has been set in the desired position.

For changing steels, the reverse-feed pulls the drill back with the steel instantaneously. The complete operation of pulling back, changing steels, and running up to the face with a fresh steel, should not take over 30 seconds.

The pneumatic feed, in combination with the Sullivan rotator, makes a machine that is practically an all-around drilling tool. The drill itself weighs 40 lb., and the pneumatic-feed cylinder and piston, with offset arm, 65 lb., so that the outfit can be handled readily by one man and carried by him into inaccessible parts of the mine. It is a popular machine with lessees at small mines, as it can be used for shaft-sinking, cross-cutting, and stoping, with minimum expense and delay.

EDITORIAL

T. A. RICKARD, Editor

TUNGSTEN is in great demand. In this issue we publish letters from our local correspondents in several mining districts describing the search for this useful metal.

CLOSING of the Panama Canal is unfortunate for the American Smelting & Refining Company's new tin smelter at Perth Amboy, New Jersey. This plant, designed to treat Bolivian tin concentrate, is nearly ready to start. It will not be the first tin smelter built in the United States, but it will be the first to produce tin.

THOMAS W. LAWSON is on the war-path again. Woe to the mine that he dishonors with his attention. Just now he is boosting Alaska Gold Mines, which needs no inflation. In a recent 'tissue' he says that the stock "will probably fly over $50 and $60, and to $75 as soon as what's doing now is done." This sort of talk serves only to discredit a splendid mining enterprise.

ONE of the features of the Exposition has been the nomination of individuals as "the most distinguished citizen" of the respective states. Arizona, by its Governor, selected Mr. L. D. Ricketts as its representative; whereupon he was the victim of a luncheon and a plaque on November 18. It is proper that a copper metallurgist should have been selected and it will please Dr. Ricketts' many friends that he should be honored thus in Arizona and California, but the president-elect of the American Institute of Mining Engineers will not modify his geniality with hauteur on that account. We referred to his nomination as President in our issue of September 25. The news of it has been received with keen pleasure throughout the ranks of the profession.

MOVEMENTS of mining engineers, recorded weekly on another page, indicate that several experienced members of the profession have visited Oatman lately. One of them, Mr. J. Parke Channing, expressed a good opinion of the district in a published interview; at least, he spoke highly of the United Eastern mine. In our issue of July 31 we published an article by Mr. Howard D. Smith on the principal developments and the general character of the district. We hope shortly to supplement that article with another. Meanwhile the daily press is being subventioned by promoters for the purpose of publishing grandiose statements concerning individual prospects in this promising gold-mining district. Such newspaper talk, we trust, will do no particular harm. Real work is being done on a great number of claims, one or two of which may prove to be veritable gold mines, like the Gold Road, Tom Reed, and United Eastern. The story appears to be authentic that the richest mine at Oatman, namely, the United Eastern, was discovered in consequence of scientific inference from evidence noticed by Mr. G. W. Long while working as a miner in the Tom Reed. He noticed that the succession of ore-shoots in the vein ceased westward and the idea came to him that the line of enrichment might follow what appeared in the level as a branch vein northward. By aid of a Brunton compass he obtained all the necessary data for 'locating himself' on the surface. Having obtained this information he went to Bisbee and consulted his friend, Mr. J. L. McIver, then shift-boss in the Copper Queen. They joined forces, returned to Oatman, bonded the claim that covered the supposed extension, sank a shaft, and struck a vein, finally, with the financial assistance of Mr. Seeley W. Mudd, developing a notable mine. The story is worthy of record as an example of the successful application of economic geology. Of course, Mr. Long will demur to the use of either 'scientific' or 'geologic' in connection with his fortunate experience, but, as a matter of plain fact, the putting of two and two together, the careful observation and the intelligent reasoning, constitute the very essentials of scientific work. Science, said Huxley, is organized common sense. It is common sense glorified to maximum efficiency. The result in this case is that Messrs. Long and McIver are part-owners of a well-organized bonanza in the sunny state of Arizona.

ELECTROLYTIC ZINC is being made at Anaconda on a working scale, namely, 10 tons per day. It is presumed that a large plant for the extraction of zinc by this method will be erected at Great Falls, but the management is reticent, pending further investigations. Cheap electricity and suitable ores are both plentiful in Montana, not to mention the highly favorable market for the metal now available. The zinc produced by this process makes the highest-grade spelter, free from impurities, such as cadmium, lead, and iron. Such spelter is in particular demand for the manufacture of brass in cartridges. Another effort, approaching success, to treat zinc ore by electrolytic precipitation is the Reed process, of which we gave a description in our issue of January 2.

SINCE the First Chief of the Constitutionalist party was recognized as the head of a *de facto* government in Mexico, we have been waiting for him to establish his authority by scattering Villa's forces and driving Don Pancho across the Rio Grande into permanent exile. Mining companies in this country are not disposed to hasten a resumption of business until Carranza makes some definite statement as to the treatment they may expect under his governance. His decree of last March

has been modified for the present, but it is intimated that he intends to impose the full force of punitive taxation next year. Railway traffic is terribly disorganized; although we have reports of trains running with several changes between Laredo and Mexico City, the supply of rolling stock is so scanty that if the mines and smelters were to resume even on half-scale the ordinary freight and passenger service would be insufficient. Not enough rolling stock survives on the National lines to handle more than a fifth of the usual business, and even this remnant is in bad repair. Recent comers from Mexico City report that the rolling stock of the Vera Cruz line is badly demoralized, as well as that of the railways farther south. Travel from the capital is largely effected on box-cars. The number of engines fit for use has been reduced to a dozen. Carranza, instead of being able to get supplies in large quantity, as he had intimated, has been unable to move foodstuffs or supplies more than a small part of the way. In the North, an attempt was made by Villa to take possession of the smelter at Chihuahua and to operate the plant, but the task was too much for the *revollosos*. An effort was actually made to start work with a little wood and coke, but it failed. After much bluffing the smelter was left uninjured. A few mines continue development work, and the Alvarado mill is still being operated. The American Smelting & Refining Company has made no attempt to resume work at any of its smelters, as it is necessary to have transport assured both for fuel inward and bullion outward, besides a steady supply of ore and flux. This company is not in a hurry to resume operations that have yielded only a small and precarious profit during the past twelve months. Cananea has suffered from changes of control. According to the last news, Villa had captured two American doctors and compelled Dr. L. D. Ricketts to pay him $25,000 in ransom. That performance is humorous as compared with the other spoilations and brutalities for which Villa is personally responsible.

Electricity in Flotation

Theories explaining flotation are undergoing development in the wake of mill-practice and laboratory-experiment. In this issue we publish a timely article on the electro-static theory as it appears to Mr. Thomas M. Bains, Jr., an assistant-professor in the Sase School of Applied Science, at Cleveland. The idea of electricity as a factor in flotation has been suggested recently in several articles published in the Mining and Scientific Press, notably in 'Why do Minerals Float?' by Mr Oliver C. Ralston, under date of October 23, in which credit is given to Mr. J. M. Callow for initiating experiments by Mr. R. C. Bacon at the Mellon Institute of Pittsburg. We may add that Mr. Callow read a paper bearing on the subject before the Salt Lake section of the American Institute of Mining Engineers early in October. This paper, when released for publication, will be printed by us without delay. Meanwhile our readers will thank Mr. Bains for his timely contribution to current knowledge. His statement of the case is to the point and gives the essentials with admirable lucidity. The electrification of the bubbles, by the friction incidental to agitation or movement through the pulp, serves to render them attractive to the metals and metallic sulphides, so that the latter become attached to the bubbles, which buoy them to the surface. The insulating film of oil serves to prevent the electric charge from becoming dissipated, and thereby breaking the froth, until it has done its duty as a conveyor of the mineral. We are also given an explanation of the function of acid in a flotation pulp, namely, that it increases the conductivity of the pulp and hastens the discharge of electricity on the particles of gangue. Of course, the older idea, utilized in the De Bavay process, that the acid dissolves an oxidized crust on the sulphides is not contradictory, for the cleaning of the metallic surface would expedite electrification. Similarly the notion that the acid promotes the wetting of the gangue is compatible with this later theory, for the 'wetting' supplies an insulating envelope. However, we shall leave the further discussion of the subject until we have given our readers the paper by Mr. Callow, to which reference has been made. It is worth noting, incidentally, that the electrical theory was not introduced into the arguments presented in the course of recent patent litigation.

Early Days in Colorado

In this issue we publish some technical reminiscences of Mr. David W. Brunton, covering his first experience in Colorado and Montana. The subject and the author join in making this article unusually interesting. Mr. Brunton is one of a small group of capable Canadians that have enriched the profession of mining engineering in America. While his preliminary instruction was obtained at Toronto, he owed his first step as a practitioner to the University of Michigan, as he tells us on another page. As an ex-President of the American Institute of Mining Engineers he obtained official acknowledgment of his distinction in engineering many years after those of us who lived in the West had learned to recognize in him one of the ablest and most honorable exponents of a difficult calling. The inventor of a surveyor's compass now in use in every quarter of the earth, he possessed that magnetic needle of character which guided him through the shoals of circumstance to a foremost place in the roster of the profession. Indeed, we are glad to publish these recollections of his early work, knowing well that hundreds of his old friends will read them with keen pleasure, while an even larger number of younger men will find in them a suggestion and a stimulus to honorable endeavor.

His story of the trip to Mineral Point in 1875 appeals to the present writer because it travels over familiar trails. Mineral Point has never fulfilled the hopes of the prospector. Situated on a ridge separating the headwaters of the Animas and Uncompahgre rivers, in the very heart of a great mineral region, it has belied the expectations of many experienced men. The andesitic

mountain sides are seamed with veins, the outcrops of which can be seen from afar as white lines of remarkable continuity. The Point itself is a knob of quartz fully 60 feet thick, from which several veins diverge, as if it were a centre of mineralization—which is just what the early prospectors assumed it to be. Mr. Brunton missed nothing by not camping there longer than he did. On his way thither he 'struck it rich' in meeting Mr. H. W. Reed, who, in later years, became connected professionally with some of the richest mines in the San Juan, notably, the Virginius. Mr. Reed lives now at Salt Lake City, as is shown by the vigorous letters he wrote in our issues of July 24 and August 14 on forestry anomalies. On his way out, Mr. Brunton descended Henson creek, passing the Ute and Ulay silver-lead mines, which, for a decade, at least, were the main support of Lake City. When he tramped up the Lake Fork of the Gunnison, he must have left the valley near Lake San Cristobal, where Enos T. Hotchkiss had started the diggings that became the celebrated Golden Fleece mine, which, in 1896, shipped nine carloads of ore averaging $40,000 per ton, and in a few months yielded a fortune to Mr. George W. Peirce, who is now at Oatman, Arizona. In following the Rio Grande valley to Del Norte, Mr. Brunton must have passed the place where 16 years later Creede sprang into life and joined with Cripple Creek in saving Colorado during the dark days of 1893. According to recent reports this district, which came to the front with N. C. Creede's discovery of the Amethyst vein in 1891, is still far from dead, even if it is not quite so ebullient as in the days when Cy Warman sang:

> "It's day all day in the day-time
> And there is no night in Creede."

How Denver looked in the period to which Mr. Brunton refers is shown by the accompanying photograph of an old wood-cut now in the possession of the Historical Museum at Denver. Forty years is no great lapse of time, as measured by the historian, but to the eager exploiters of the Great West it is as a geologic period. In those Eocene mornings of 1875 Mr. Brunton found Central City and Georgetown in the throes of metallurgical revolution. The free-milling precious-metal ores of the oxidized zone had been succeeded, at a shallow depth, by heavily pyritic and relatively complex ores. Roasting before pan-amalgamation and hyposulphite leaching had brought the Brückner, Küstel, and Stetefeldt furnaces into prominence. The Collom jig had just been invented; but concentration was crude. N. P. Hill had established his smelter at Black Hawk, and had just been joined by Mr. Richard Pearce, now living near Liverpool, in England, after a long career of useful accomplishment. The Stewart mentioned by Mr. Brunton was J. O. Stewart, who had an important custom-mill at Georgetown. He had built an annex for the application of the Hunt & Douglas process, a method lending itself to graphic representation by the chemical formulæ that used to bother many of us in our student days. The process is now obsolete, but the names of the two inventors live in the annals of mining, for Thomas Sterry Hunt gave to chemical geology many provocative suggestions and Mr. James Douglas has lived to be one of the most beloved of men, known the world over for his skill as a metallurgist, his sagacity as an executive, and his public spirit as a citizen.

Coming to the Leadville reminiscences of our distinguished contributor, we may be permitted to say that the talented author of 'The Led Horse Claim' attended the recent meeting of the American Institute in San Francisco, being the wife of one of the leaders of our profession, Mr. Arthur DeW. Foote, long identified with the successful operations of the North Star mine at Grass Valley. In regard to the Van Zant story, the present writer arrived at the Blue Bird mine on the very morning when the news of his suicide reached William Keller and Mr. Philip L. Foster, the latter now resident at New York as the representative of the Exploration Company. The former died a few years later at El Oro. Austin H. Brown was then in charge of the big mill; he died in 1913. Mr. Charles Van Zant was also at the Blue Bird on that date, in 1891; he called at this office a few weeks ago. The Blue Bird has played a part in the lives of a great many notable men, as is shown by Mr. Brunton's notes concerning the early litigation at Butte. Those apex-suits still proceed with undiminished keenness and continue to furnish a grindstone for sharpening the wits of men mentally alert to the niceties of structural geology. Our readers will like Mr. Brunton's account of his own part in them, and they will appreciate the letter from Mark Twain to H. H. Rogers. Truly, "virtue, as well as ballast" is required for a safe voyage to any port in life. The strength of purpose and continuity of effort that give direction to human endeavor are shown in the auto-biographic records of our successful engineers. In the days of their apprenticeship to the profession, they applied themselves with sincerity of aim to the acquirement of knowledge and experience, accumulating a mental capital that yielded generous dividends when subsequently opportunity knocked on their door.

American Potash

In our issue of August 7 we reviewed the prospects of a domestic supply of potash and referred to the alunite deposits of Utah as being of great promise. That promise apparently is to be fulfilled. Actual production has begun. A shipment of potash was made in October, the first carload being consigned to Florida. It averaged 93% sulphate of potash. The scene of this new and important industry is Marysvale in Cottonwood canyon, at the foot of the Tushar range, and about six miles from the Denver & Rio Grande railroad. The deposit consists of a series of long lenses of pinkish-white alunite, outcropping on the mountainside, now penetrated by adits, from which the mineral is conveyed by aerial tram to the bottom of the valley. This lode of pink spar in andesite has been a disappointment to many prospectors, who had tested it for various metals, particularly gold. It was generally called heavy spar or barite. Some local

quidnuncs said it was wavellite. An assayer at Salt Lake City, Mr. A. E. Custer, was the first to suspect its real value, finding a high percentage of alumina; finally a specimen sent to the Foote Mineral Company at Philadelphia was returned with the correct label: alunite. The mineral contains 10 to 12% potash, 34 to 37% alumina, 13% water, and 36 to 38% sulphur tri-oxide. In Bulletin No. 511 of the U. S. Geological Survey, issued in 1911, this deposit at Marysvale was mentioned as "an important deposit of alunite," containing both potash and aluminum. In the same bulletin it was stated that the potash was soluble; but no workable process had been devised at that time. A group of men associated with Mr. J. Ogden Armour had obtained control and exploratory work had been started under the direction of Mr. Howard F. Chappell when the War cut off German supplies of potash, sending the price in this country from $50 to about $300 per ton. That, of course, offered an inducement to go ahead with the enterprise. Experiments finally have proved that careful roasting in a rotary kiln expels the sulphur, leaving a pulverulent product from which the potash can be dissolved with hot water, while the insoluble alumina remains in the residue when the two products are separated by a filter-press, the solution passing to vacuum-pans where boiling followed by evaporation yields a crystalline residue of sulphate of potash, which is then dried, pulverized, screened, and sacked for shipment. The first unit of plant has a capacity of 25 tons of such potash per day. The undigested aluminous residue obtained in the course of this treatment may become a valuable by-product, as a source of metallic aluminum; indeed, it is difficult to say which of the two, the potash or the aluminum, will prove the more valuable. Just now the demand for the former is so great that it is the more attractive; in normal times the yield from both will be required to ensure a profit. While the Armour Fertilizer Company is represented in the directorate, we note that Mr. Sidney J. Jennings, of the United States Mining, Smelting & Refining Company is a vice-president, Mr. Chappell, an experienced chemist and the prime mover in the enterprise, being president of the company, which is called the Mineral Products Corporation. Obviously there is no lack of money, ability, and technical knowledge. The deposit mentioned is only one of several in the same locality; other outcrops have been traced; and numerous attempts to exploit them are now assured. All of them are on unpatented lands, so that the question of title may check development, until the Federal Government has explained its policy.

Meanwhile there comes good news concerning Searles Lake, in San Bernardino county, southern California, where, as most of our readers are aware, a big saline deposit is being exploited for potash by the American Trona Corporation, a company in which the Consolidated Gold Fields of South Africa holds a large, but minority, interest. A railway 30 miles long has been built from the site of the deposit to the Southern Pacific railway at Searles, and a refinery is now being erected at San Pedro, on the coast. For two years this enterprise has hung fire, owing to difficulties in the extraction of the valuable salts. The dry lake contains a concentration of brine, estimated at 60 feet thick over 11 square miles, containing an average of 6½% potash, equivalent to 10% potassium chloride. A 10-inch pipe-line is now being constructed to convey the brine from the lake to the concentrating plant at Trona, where the water is evaporated. The potash and borax become concentrated in a product that is shipped to San Pedro, where the valuable salts are separated and refined before shipment. It was ascertained that the pumping of the brine direct from the lake to tide-water was impracticable, on account of the cost of the required piping; hence the decision to concentrate the valuable salts at one plant and to separate and refine them at another. The process adopted, under the direction of Mr. C. P. Grimwood, involves fractional crystallization in tripple-effect vacuum-pans, removing both the chloride and the sulphate of sodium at the Trona plant, thus leaving residuum that will yield potassium chloride and sodium tetra-borate at the San Pedro refinery. When pure the potassium chloride will sell for $300 per ton, but a lower-grade salt is used in the fertilizer industry. As for the borax, there is no trouble in finding a market. It is expected that both potash and borax will be produced by the Trona Corporation not later than April next.

Many references have been made recently, in the non-technical press, to the winning of potash from kelp or sea-weed. This can be done by drying and grinding the kelp, yielding a product that contains 10 to 13% potash and resembles in composition the kainit of the Stassfurt deposits. However, no contribution of potash from such a source is within sight, despite several attempts. From consular reports it appears that the use of kelp as a fertilizer has been much stimulated in Scotland since the War began; it is also an old industry along the French coast, and particularly in the Scilly Isles, off Cornwall, where it is used in truck-gardening to the extent of 40 tons of sea-weed per acre. But, at present, this source of fertilization is of no consequence as compared with the mineral deposits mentioned.

The importance of these efforts to produce potash salts is clearly indicated by the statistical evidence. In 1913, the latest normal year, the United States imported 306,000 tons of potash, worth $10,800,000, of which $7,000,000 represented potassium chloride and $1,700,000 potassium sulphate. These figures do not include fertilizer salts. Speaking broadly, the carbonate is used in glass-making, the cyanide in metallurgy, the nitrate in the manufacture of explosives, the sulphate and the chloride in the fertilizer industry. As indicated above, 80% of the potash imported is intended to aid agriculture. In 1914 the sulphate was worth $41 and the chloride, which contains less potash (K_2O), sold at $33 per ton. The War not only stopped shipments but an embargo on the export of potash salts was promulgated by the German government at the end of January 1915. Hence the potash famine in this country and the keen interest awakened by the work now in progress, both in Utah and California.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Mining Engineer and Prospector

The Editor:

Sir—I have read with interest the various letters recently appearing in your magazine on the relation of mining engineers and prospectors to mining development. The subject is not only interesting but serious. A healthy activity in mining calls for not only the development of prospects but also the continued exploration of old mines and old districts.

Anyone who has had opportunity to spend some time in the mountains of the Western states will realize that of the prospects the vast majority are worthless, judging from what we know of geology and the theory of ore deposits. There are, however, a goodly number that deserve to have money spent on them, although in many of these cases he who spends the money may never get it back. The persevering, optimistic, and intelligent prospector has been the greatest factor in the development of the mining industry and there are still some of them left, although probably outnumbered by men less dependable. The chances for the prospector without capital are becoming less and less, and the future prospecting will have to be done with the diamond-drill or by powder and fuse in large quantities. One of your correspondents quotes the head of one of the large exploration companies as saying that it is difficult to see where the big mines of the future are coming from; this is liable to be the attitude of a mining man after he has been in the office for a while reading the adverse reports of competent engineers who have been sent out to look at the great mines discovered by a pseudo-prospector and promoted by a pseudo-promoter. When, however, a mining man gets on his hobnailed boots and gets a little closer to nature he usually sees many places where some thousands of dollars judiciously spent might make another big mine.

Far more plentiful than prospects, also, are mines that have once produced but are now idle, or that are quite extensively developed but have produced very little or nothing. Many of these show all the ear-marks of good properties but seldom is there any ore available. It takes money to go in and find ore and that money may be lost. Mining is not a sure thing, and the mining engineer who waits for a dead-sure thing to recommend is liable to wait a long while. On the other hand, those who keep at it and use the best mining judgment they can get, spending money on first one thing and then another, usually win out. On a sure thing one cannot expect more than 4 to 6% on money, but in mining there is no limit. The sooner the public (and mining engineers, too) come to the proper realization that mining is a man's game in which money may return enormous profits or may be lost, and the public demands a judicious expenditure of the money that is invested, just that much sooner will mining be in a healthy condition.

CARL A. ALLEN.

Denver, November 4.

The Prospector

The Editor:

Sir—Under the above heading in your issue of October 16, Mr. Ernest G. Locke replies to mine of September 18. His reply indicates the effect I intended, that of caving the ground and relieving the prospector from the overburden of the hostile engineer and press. Mr. Locke has drawn a faithful life-size portrait of the average mining engineer. That Mr. Locke, when examining a prospect, brings into action the same care, skill, and experience that he would give to a developed mine, speaks well for his methods—more power to him. But why inject into a report so much caution; are geological conditions always unfavorable to a prospect becoming a successful venture? If a man's training enables him to value conditions accurately, why not state the value of what is seen? It may be because the mining engineer is none too sure of understanding the local conditions that he hesitates to recommend a prospect. My own view-point takes in the field not only as a prospector but as a responsible adviser to a critical investor, a position aimed at since 1880 when I was in Rhodesia.

My interest and sympathies will always be with the prospector; to show that he is regarded as an unimportant element in the mining field, I will cite an experience of my own. After years of hard work, my feet finally landed on the pay-shoot and it was not difficult to show a clean clear profit to the investor. My spirits rose as he remarked. "Now Mr. W., I find that you have a very interesting proposition; you have quite a little ore developed of good grade and some on the dumps. I like the appearance of your orebodies and the facilities generally. Now, what do you ask for the property?" I outlined a scheme of payments thus: nothing down, first payment in six months, the remainder of price to be paid thereafter in three installments of six months interval, a royalty of 10% to be paid on all ore milled and to apply on final payment. Could anything be fairer? Did I sell? Wait and see. "Now Mr. W., will you give me an option on it for 60 days?" "No sir." "Very well. I should

like our Mr. So-and-So to see it." "All right." After many days, Mr. So-and-So arrived; instead of an associate investor, he was from boots to eyebrows relentlessly and irrevocably a mining engineer, very anxious to get back to the office. With a jaunty debonair air, he wished to be shown the vein. I handed him a short piece of candle; I knew that would be enough. He took three samples, and concluded his labors in 30 minutes. To examine a prospect in 30 minutes is about what I expected from an office product. Of course nothing escaped his lightning survey. It was a prospect; that settled it. His faculty for careful appraisal was atrophied by comfortable conditions in an office. He could not afford to risk his position by recommending a prospect, because his value to the firm is measured, not by the amount he makes for them, but by the amount he saves them. Also his limitations are fixed by training, his horizon is so bounded by caution—extreme caution—that imagination is quenched and he falls to the level of a notary-public. Such men as J. F. Kemp or J. E. Spurr, never balk at analysis of conditions. The logic with which they trace a mineral and its carrier to its final deposition wins the prospector, because he knows whenever investigation is started by them, or any other conscientious engineer, they lose sight of the owner and investor. The prospector knows that patient investigation is in progress and has no kick to make if the verdict is against him. If I were a mining engineer, which I wish I was, and called to pass on a prospect, I'd forget the office, and concentrate whatever ability I possessed on giving the prospect or mine a fair shake.

Wm. W. Waters.

Havilah, Cal., October 24.

The Mechanical Efficiency of Crushing

The Editor:

Sir—It appears to me that instead of Mr. Stadler casting insinuations in respect to one's sanity and displaying utter contempt for those who do not agree with him in the application of Kick's law of crushing, he might enlighten us with some of his own experiments, proving his contention. It may be that I have overlooked some of his writings on the subject and therefore have not seen his practical proofs. Mr. Gates has had the advantage of a well-equipped laboratory (as I understand) and he is a qualified expert (I believe) and yet his results differ from those obtained by Mr. Stadler's authorities of "half a century ago." Mr. Stadler must know that problems settled half a century ago are being unsettled every day, so this argument has little weight. Because some of us have not the use of well-equipped laboratories there is no reason why we should accept conventional theories when simple experiments prove that the experts may have overlooked something. It is poor argument to first cast personal reflections and then try to thrust your argument down the other fellow's throat, better to treat the other as a human being and then try to convince him of his mistake. It has been generally understood that the Mines Trial Committee of South Africa took this subject in hand, likewise that a full report of the result of the investigations was not made public. I hope I am wrong in this, but I have read that such was the case in one of the technical journals. If this is as represented, will Mr. Stadler procure and give to the public the results of these investigations? In my opinion this will be more to the point than proving an opponent to be a weakling and then saying "I myself am only sane." It is generally understood that inventors, poets, and musicians have a touch of insanity and as these offsprings of the human race have an acknowledged place in the economy of creation so possibly may those who kick at "Stadler's theory" as you, Mr. Editor, so well designate it. What is needed is argument, new ideas, encouragement to investigate, something that is not final; in fact, we must have argument and publicity to promote the slightest interest in a subject, but not personalities. I am quoting from memory but I believe Mr. Stadler has stated that the comparative efficiency of stamps and tube-mills on the Rand varied as 70:17 or 4:1. Any practical operator knows that this is not so in respect of tube-mills in other localities, so we must assume that either tube-milling on the Rand is little understood or Kick's law is out of joint somewhere. The argument may come back that by the Rittinger theory the relative efficiency of stamps and tube-mills under like conditions closely approximates this result. No doubt it does, which clearly indicates that the subject is still open for investigation, that there is a possibility of both theories being far from true and that a crank may find the right answer.

While I feel greatly flattered that on mature consideration by Mr. Stadler my remarks were worthy of a reply I can assure him that had he passed me over I would not have been offended. I can also assure him that his method of attack has not helped his cause, on the contrary to some it may appear that when a scientific man gives way to personalities in argument his cause needs first-aid.

Algernon Del Mar.

Los Angeles, November 9.

Moving Machinery

The Editor:

Sir—I believe many mine superintendents, and perhaps, also some engineers, will be interested in a series of contributions from others on the subject of moving heavy pieces of machinery, such as are usually part of the equipment of mines and metallurgical works. The foundries and shops, where boilers, engines, mortars, crushers, and other heavy machinery is made and assembled, are usually equipped with electrically-operated cranes by means of which pieces of machinery weighing many tons are picked up at one place and set down in another with the greatest ease, by two or three men. These machines, when ready for shipment, are lifted on board of a railroad-car, which is run into the shops and sent away on its long journey to mines, often hundreds and even thousands of miles distant from the place of

manufacture. When this machinery arrives at the station on the railroad nearest the mine, there may, or there may not, be available a crane or derrick by aid of which the machinery may be moved from the railroad-car to the depôt platform, or even to place it on the freight-wagon on which it is to be hauled to the mine, which may be many miles distant in the mountains.

But, on arrival at the mine, there is no electrically-operated traveling crane—not even a shears or derrick—with which to lift and move the heavy machine from the wagon to the ground, or onto a crib of timbers, to say nothing of placing it in its permanent position on the foundation prepared for it. At such isolated mines, particularly the small ones, about the only things usually available for such a purpose are timbers of various sizes, wedges, ropes, pipes in short pieces for use as rollers, planks, and crow-bars. At a few mines there may be found 'jacks' of one kind or another, though too often these very useful adjuncts are missing; but there are few mines that do not possess one or more sets of chain-blocks.

The problem upon which I desire enlightenment is the methods generally employed in shifting heavy machines from one position to another with no other mechanical implements other than those mentioned in the last paragraph, in order that the best methods be selected from any that may be offered. To me it seems that the department of your paper devoted to 'Discussion' is the best place in which to seek the desired information.

I am sure there are many who have had just such problems in their pioneering experience, and have found a way out of the difficulty, and there are as many more who would be most grateful for any suggestions made by those who will contribute something to this subject from their experience along these lines. As I do not wish something for nothing, I am willing to set an "excellent example" by describing the means I employed to set a heavy oil-wagon equipped with a 1200-gallon steel tank on its feet after it had been carelessly driven off the grade and overturned by a teamster, where it lay on its side four feet below the level of the roadway, a mile from the mine.

The great wagon with its tank weighed several tons, but fortunately was empty. When I first saw it lying there below the road in a position where it might easily roll over a few times more, thus continuing its journey down the mountain, it presented anything but a pleasant prospect for the early resumption of usefulness. It was absolutely necessary to get that wagon back on the road at the earliest possible moment, or the fuel-supply would be shut off, and this meant the closing-down of the works. It was cheaper to get the wagon back on the road.

I took about a dozen men; twenty pieces of 6 by 6-inch timber, mostly posts and caps of drift-sets already framed and ready to hand in the yard; a coil of 100 ft. of 1-inch manila rope; a two-ton chain-block; several crow-bars; two jack-screws; a piece of 8 by 8-in. timber 12 ft. long; a piece of ⅜-in. steel rope picked up in the timber-yard, and two or three pieces of inch-rope each 12 or 15 ft. long: also picks and shovels for the entire crew, with a rock hammer or two. This equipment was such as can be picked up around any mine in a few minutes. The whole outfit was placed in a wagon and started for the scene of the accident as quickly as possible. The men took a trail over the hill, all arriving about the same time. At once I set two men at work digging a hole on the upper side of the road opposite the overturned wagon and about 20 ft. from it. This hole was sunk to a depth of about 4 ft. and was kept as small as possible. When it had reached this depth the piece of 8 by 8-in. timber was placed upright in the hole and the rocks and dirt filled in around it, the fill being tamped as firmly as possible. The post was inclined backward at about 70° from the horizontal. To render this post more secure I had an inch-steel bar driven in the ground to the depth of several feet at a point 10 or 12 ft. back from the post. The little steel rope was now made fast near the top of the post and the other end was wrapped around the steel bar driven into the ground. Meanwhile, two men had placed the long manila rope about the tank and the wagon in the form of a sling, the rope being secured so that it could not slip. The several pieces of framed timber were placed on the ground near the wagon, to be used in building a crib beneath the wagon when it was lifted by means of the chain-blocks, for it was evident that the wagon could not be placed upright without running out the chains at least twice, and the crib of timbers would hold the wagon in position while the blocks were being changed. The men not otherwise employed were set at work grading from the position of the wagon up to the roadway, so that the wagon could be hauled back upon the road without the danger of again overturning when once more upon its feet.

When the 'dead-man' had been firmly set in the ground and further secured by means of the steel bar and little steel rope, a short sling, made from one of the pieces of manila rope, was thrown around the dead-man, well-down, and the chain-blocks placed in position, being hooked into this short sling at one end and into the large sling around the wagon at the other. When all was in readiness, three men began to work at the chains of the blocks. A great deal of slack and stretch of the rope had first to be taken up, and but little impression was at first made on the wagon, but at this juncture a piece of 6 by 6-in. timber about 7 ft. long was placed on end under the rope-sling, one end resting on the ground, the other end being against the rope. This timber was inclined toward the wagon at an angle of about 40° from the horizontal. The effect of this device was to give a more direct lift to the sling, and its effect on the wagon was promptly noticed, for as the men pulled on the chains, the sling-rope binding on the end of the timber, began to lift the wagon and in a short time we were able to begin placing the timbers beneath the wagon as it continued to rise, thus supporting it in position while the blocks were run out again. In a few minutes more the heavy vehicle was lifted to a point where it once more passed its centre of gravity (on the proper side, this time). The grading having been completed in the meantime, the team was

hitched to the wagon once more and quickly left for the railroad to get another load of oil, as fortunately nothing was broken by its fall. The whole matter of lifting this great wagon and getting it out of the way did not take more than 45 minutes. The roadway was repaired and widened at this place, though it really did not require it. The careless teamster was one of the best in the country, having passed this turn in the road in safety a thousand times during several years in this service, but, like some other good men, he became a little careless, and dumped his wagon into the ditch, springing from his wheel-mule just in time to escape injury himself.

W. H. Storms.

Berkeley, October 24.

Mine Accidents

The Editor:

Sir—Accepting the invitation in your issue of October 9 to discuss the question of accidents in mines and their causes, I offer for consideration the following statistics of fatal accidents or casualties in the mines of Houghton county, Michigan, for the year ending September 30, 1915. The mines in which fatal accidents occurred during the year in question are the Quincy, Champion, Trimountain, Baltic, Hecla Branch, South Hecla Branch, Calumet, Red Jacket Shaft, Isle Royale, Superior, Centennial, and Hecla Amygdaloid.

With a total of 16,005 men employed, only 34 casualties occurred, showing a proportion of casualties of 0.0021. Classifying the fatalities according to occupation, we have 11 miners, 6 timber-men, 10 trammers, 3 track-men, one shift-boss, one shaft-boss, one sprinkler, and one roller-fixer, and according to nature of accident: falls of rock 24, struck by skip 4, struck by timber 2, drilled into missed hole 1, fell in chute 1, fell off skip 1, and struck by car 1.

I have read carefully the testimony of witnesses and the verdict of the jury in each of the 34 cases, as stated in the county mine-inspector's report. In only 8 cases out of the total of 34 can the accident be clearly attributed to carelessness on the part of the men killed. Four of these were cases of men being struck by the skip; one case was that of a man who fell off the skip; in another case the man fell in a chute; in another a miner drilled into a missed hole. Only one case of fall of rock can be stated as due to carelessness. In these 8 cases of apparent carelessness only 2 miners were killed, the others being timber-men, trammers, and men doing minor jobs underground.

Accidents from fall of rock appear to be the most numerous, 24 of the 34 being of this nature. The question then is, are these falls of rock due to carelessness on the part of the men? In 9 of these 24 cases miners were killed and in 2 other cases a shift-boss and a shaft-boss were the unfortunate ones. All of these men were probably experienced underground men. In 10 of these cases the verdict of the jury was that death was caused by the accidental falling of loose rock. In nearly all of the 24 cases witnesses stated that the ground looked perfectly safe, in many cases had actually been tested, and that they were willing to work in those places where the accidents occurred. In two of the cases considered under 'fall of rock' death was due to pneumonia indirectly caused by injuries.

Since some may question my ability to judge properly a case of fall of rock, let us consider one or two cases in detail. Capt. William Jolly and Supt. Mendelsohn went into the 17th south stope on Wednesday April 28, and found a miner back about 12 ft. from the breast, which he had just drilled. No blasting had been done since the Thursday previous. Mr. Jolly called the miner and told him to bar down some loose rock. The miner could see no reason for doing this, since no one was working there. However, Mr. Jolly told him to bar it down anyway. Mr. Jolly then walked toward the hanging, when some rock fell causing his death. The jury rendered a verdict of accidental death.

Capt. John Mitchell walked up the stope to where some men were charging holes. Witnesses stated that they had walked up and down in the same place all day. Mr. Mitchell had just asked the men how they were getting along when a piece fell from the hanging, causing his death. The jury reported "that Capt. John Mitchell came to his death by an accidental fall of rock while attending to his duties."

Consider the case of Jim Nuceetti, a miner, drilling a hole with a machine. A fall of loose dirt from above caused him to fall over the stope. John Dutich was struck by a piece of falling timber, which probably fell from the front of the skip-catcher. Witnesses stated that 20 or 30 air-shocks occurred, and these might have shaken the piece of wood off. In another case a miner was killed by a fall of rock due to an air-blast. Can these deaths be attributed to carelessness on the part of the men?

Let us now consider one or two cases of a different nature. In the case of the man who felt so fine that he sang all night while cleaning down the shaft and finally fell off the lip of the skip we have reason for assigning his death to carelessness.

Joe Nanfil was struck by a piece of hanging rock after he had been repeatedly warned not to go in the shaft while the timber-men were working in the shaft. This too appears to be a case of carelessness.

Stanislaw Sichlucki came to his death by falling in a chute after having had strict orders prohibiting him or any one else from going there.

Whether the death of Otto Hess, caused by an explosion resulting from his drilling into a missed hole which had powder in the bottom, can be attributed to carelessness is a question. However, I have so considered it.

The records and statistics that I examined prove, in my opinion, that the majority of deaths in the mines of Houghton county during the year ending September 30, 1915, were not due to carelessness of the men killed.

W. E. Hopper.

Houghton, Mich., November 10.

Technical Reminiscences

By D. W. BRUNTON

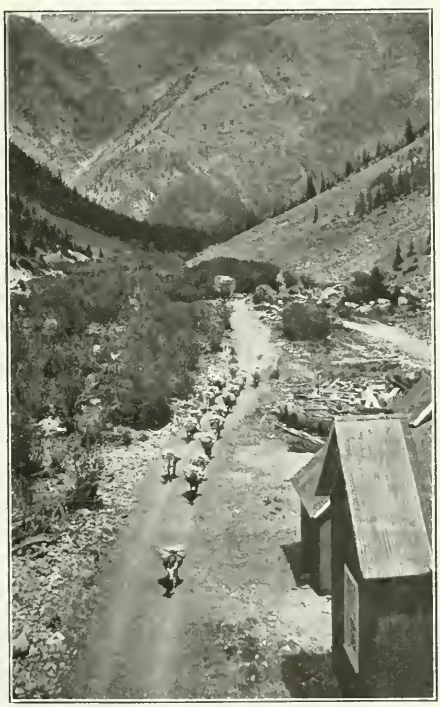
Early in June 1875, Major C. H. McIntyre, president of the Dakota & San Juan Mining Co., came to Ann Arbor, Michigan, to see if he could engage a young mining engineer to go out to Colorado with him to take charge of the engineering department of his newly organized mining company.

As I had been taking a special course at the University of Michigan, some of the faculty were kind enough to recommend me for the position, which I needed fully as much as the Dakota & San Juan Mining Co. required an engineer. Arrangements were speedily concluded and we immediately started for the West, arriving in Denver on June 20. The trip from Chicago west at that time was far from being as comfortable as it is today, but it was enlivened by the sight of countless herds of buffalo, which were still roaming over the plains almost unmolested.

At that time the American House on the corner of 16th and Blake streets was not only the leading hotel of the city, but was situated practically in the centre of the business district. What is now the business centre of Denver was at that time the residence district, and the present fashionable residence portion of Denver was then densely populated by prairie-dogs. Three or four years later, when Major McIntyre decided to make Denver his home, he bought a house away out in the country where, as he expected, he would always have an entirely unobstructed view of the mountains. This residence has lately been pulled down and its site occupied by the Bank Apartment house, 1233 Sherman avenue. Mining and the passing years have both dealt kindly with the Major as he is now 'on Easy street,' hale and hearty at the age of 78.

We remained in Denver over a week, engaging a force of miners and purchasing mining supplies, and on the morning of the 29th left for Pueblo over the Denver & Rio Grande, which was at that time a narrow-gauge railroad. To test our camp equipment and to make sure that we had everything necessary for the long trip from Pueblo to Mineral Point, in the San Juan, where the Dakota & San Juan Co.'s mines were situated, we decided, instead of going to a hotel, to utilize our camping outfit and pitched our tents on a small island in the Arkansas river. A tremendous rainfall somewhere upstream caused a rapid rise of the river, which overflowed the most of the island, put out our camp-fires, and even came up to the edge of the tents. We spent the latter half of the night in watching the flood and debating whether we should try to wade to the mainland or take to the trees if the flood should continue to rise and render our position untenable.

The roads leading out of Pueblo at that time were nothing but wheel-tracks; as these did not extend over half the distance to Mineral Point, we decided to pack the entire distance rather than change methods of transportation midway. Progress was slow, as the packers were Mexicans and knew more about *mañana*[1] than *prisa*.[2] Traveling through a new and beautiful country, however, had many compensations. Game was plentiful;



A PACK-TRAIN ON THE ROAD TO SILVERTON.

the streams had not then been whipped by thousands of fishermen, so by keeping a few miles in advance of the expedition during the day, I had glorious sport, the results of which greatly improved our bill of fare and lessened the drain on the supply of provisions which we were packing with us.

Late one afternoon, just as I was about to start back for camp, clouds of extraordinary density scudded over the horizon and darkness, accompanied by a terrific rain, came on so quickly that I was barely able to find my way to a little dirt-covered shack which I had passed not long

[1]Tomorrow. [2]Hurry.

before the storm came up. The cabin had been built by a home-seeker from Missouri who had a wife and two children. They had only one bed, very little to eat, and, even before we had disposed of a scanty meal of saleratus bread and bacon, the rain commenced to percolate down through the mud-covered roof and little murky streams were soon dripping down in every part of the cabin. I sat up all night on a cracker-box in a corner of the room with a *poncho* over my head trying to keep dry and get a few winks of sleep; but, after a most uncomfortable night, which seemed to last an age, morning dawned as clear and bright as if storms would be forever unknown.

I found my half-drowned horse and started back for camp. About the middle of the Wet Mountain valley I ran across a man who had been caught by the storm, spreading out his wet blankets on some rocks. Stopping to talk, I soon ascertained that he was a mining engineer for another mining company whose outfit was a few days behind ours on the same trail. This engineer was H. W. Reed. Leaving his blankets to dry, he rode back with me to our camp for breakfast, after which we hunted and fished together and had such a glorious time as only young, care-free, engineers in a new country could have.

One night we returned to camp and found everything in confusion. The packers, realizing that the expedition was in a wild country where there were no wagon-roads and no possibility of obtaining other packers, had struck. The president and secretary of the company were in a quandary what to do: whether to give in to the unreasonable demands of the packers or to wait there until new packers could be obtained from Pueblo. In an unguarded moment I suggested that, as the miners who were going in to the mines were doing nothing on the trip, there was no reason why they should not be trained to pack. This view was pronounced sound, but the question was, how were they going to be trained, as there was nobody who knew anything about packing except the strikers. After discussing the thing for some time, Reed and I came to the conclusion that we had seen the animals packed in the mornings often enough to be able to do it, so we had one of the quietest burros brought out from the herd and started in to see what could be done. A few attempts showed us that the mysteries of packing were not to be solved off-hand, but by sticking to it for nearly a day we finally learned how to throw the 'double-diamond hitch,' and then commenced to teach the miners, some of whom showed considerable aptitude, but the majority of them lacked both the knack and inclination. Still, they all saw the necessity for it, and after a day or two spent in practising packing and unpacking we were able to move, the foreman of the mine-crew taking charge while Reed and I rode along behind to give expert advice, which, in this case, was rarely successful unless accompanied by a complete physical demonstration. However, all things come to an end; after a laborious but uneventful journey we reached Mineral Point and began the development of the mines.

This alleged city had an altitude of 11,700 ft. and contained a motley assortment of tents, together with a few poorly-built log-cabins. The rain-fall was so great and flurries of snow so frequent that a tent was far from being comfortable as a residence, so Reed and I began looking for some one who could build us a cabin. We finally found a carpenter who said he could build the cabin if he had the logs. We were unable to find any one who could or would furnish the logs, hence Reed and I decided to do this ourselves. He had been brought up in the Maine woods and I on a Canadian farm, so we were both familiar with the use of an axe and soon had the requisite number of trees cut down and logs cut to the desired length. Then we were fortunate enough to find a packer who hauled them to the site with an old half-broken pack-mule. Once established in our new home we made ourselves as comfortable as possible, but, of course, were obliged to do our own cooking, and the same room had to be used for everything, including surveying instruments and my little assay-furnace, which was set up in one corner.

The development of the mines showed large bodies of ore, most of it extremely low-grade silver-lead. It was the company's intention to continue work on the mines throughout the winter, but an early snow-fall closed the pass at the head of the Lake Fork of the Gunnison before the winter supply of provisions arrived and we were all obliged to migrate.

There were no snow-shoes in camp and tramping through the deep snow over the range was the hardest trip I ever undertook. When we reached what is now the site of Lake City we found some changes, a few log-cabins had been built and one of them bore the sign 'Restaurant.' Reed and I, who had been cooking for ourselves all summer, immediately started to vary the monotony by ordering a meal at this alleged restaurant. The bill of fare consisted of very tough fresh beef and saleratus bread, after which they brought in some stewed dried apples, whereupon I remarked to Reed that I never expected to see dried apples served for dessert. He replied immediately with a great deal of emphasis: "Damn a country where dried apples are a luxury."

Conveyances of any kind were unobtainable, our animals were completely worn out, there was nothing to do but for us to finish the journey on foot; so we tramped up Slumgullion Pass, across the Cebolla, and down Spring gulch to the valley of the Rio Grande, which we followed down to the town of Del Norte, where we were fortunate enough to find a settler with a light wagon who agreed to drive us through San Luis Park, over Moscow Pass, down through the Wet Mountain valley, to Pueblo, where we took the train for Denver.

Coming direct from the populous East in the early summer, Denver had seemed to us a little, poorly built, country town, but, after four months in the wilds of the San Juan, when we came back to Denver it seemed to us an immense city and its somewhat primitive hotels the height of luxury.

Central City and Georgetown were at that time the oldest and most prosperous mining settlements in the State, so I decided to see something of the mines and

mills there before going East for the winter. At Georgetown, the last place visited was the Stewart mill, which, at that time, was the largest in the Rocky Mountains. The mill treated almost exclusively the high-grade silver ores of the district, the processes employed being the Von Patera and the Hunt & Douglas. Hyposulphite of soda was purchased in Germany, and, owing to the excessive freight-rates, it was extremely expensive; in addition to which, for various causes, the consumption was extraordinarily high. In the course of the visit it transpired that the proprietors were looking for a mining or metallurgical engineer who knew enough about chemistry to maintain the solutions in working order without excessive loss. The opening seemed too good a one for me to pass over, so I wired to Denver for my trunk and began the study of the interesting problem before me.

It was soon found easy to keep the solutions in working order, but the large loss of chemicals per ton of ore treated could not be reduced. The difficulty was finally solved by the manufacture of hyposulphite of calcium from the waste sulphur di-oxide from the roasting-furnaces. This furnished a supply of solvent so cheap that the question of loss became relatively unimportant and the cost of solution replacement was reduced to a small fraction of what it had been before.

The Hunt & Douglas portion of the plant, thanks to the careful instructions and constant advice of the two inventors, proved most successful, and, to me, one of the most gratifying results was the lasting friendship formed with both Thomas Sterry Hunt and James Douglas.

This work proved most interesting and occupied the winter of 1875-76, but when spring came, and with it reports of new discoveries in the various parts of the West, I became restive. Engineers were scarce, examinations and investigations were offered freely, therefore I naturally fell into the work of making examinations and investigations in widely separated localities, which gave, not only a widened experience, but an acquaintanceship with the operators and mines of the different districts that has ever since proved extremely useful.

In 1877 the discovery of lead carbonates in the hills bordering on the old alluvial diggings of California Gulch electrified the entire country and the magic word Leadville was on the lips of every one. Existing engagements kept me out of the new district until the spring of 1880, when I reached the camp in time to pack a gun and take a hand in the suppression of a strike. The privates were willing but undisciplined, and very few of the officers had any military training whatever. When the strike was ended I came out of the ordeal with a major's commission and a fixed determination that in the future I would do what I could to head off strikes rather than to participate in repressing them.

AFTER THE FIRST FALL OF SNOW; THE SAN JUAN RANGE.

Conditions in Leadville during its early days are so truthfully and graphically portrayed in Mary Hallock Foote's most interesting novels 'The Led Horse Claim' and 'John Bodewin's Testimony' that it would be a waste of time to describe them here, but one occurrence, with which I had some connection, deserves especial mention.

The Robert E. Lee, though not one of the earliest discoveries in Leadville, soon proved to be the richest mine in the district, and when it had reached a point where it was paying dividends of $90,000 per month its workings were completely flooded by an influx of water that for some time defied the efforts of the company to handle it. J. Y. Marshall, the president of the company, came to see me several times about it, but we could never come to

terms, principally, I suppose, because I had the boyish idea that the unwatering of a mine capable of paying that amount of dividends should contribute somewhat heavily to the financial assets of the engineer carrying on the work. One day, however, his patience becoming exhausted, he came down to see me and said, "Pump out that mine as quick as you can and when you get through send in your bill." Previous attempts at drainage had shown approximately the amount of water to be handled, which was entirely beyond the capacity of any stock pumps obtainable. I measured the compartments of the shaft carefully and then placed an order in the East for pumps as large as could possibly be passed through the openings. The pumps, after some delays, finally reached Leadville. At this time Mr. Marshall was a candidate for the office of district judge and, while he absolutely declined to take any part in the political campaign, he conceived the brilliant idea that, as the pumps would be ready to start a few days before the election, he could, without the loss of prospective judicial dignity, give a big reception when the unwatering of his mine began. The date for starting the pumps being set, my mechanics made several surreptitious trials of the machinery a day or two before to make sure that everything was right. Invitations to the 'blow-out' had been sent to everybody in the district from mine-managers down to nippers. The mine-office was filled with champagne and cigars for the managers and superintendents, while the shaft-buildings and ore-houses were loaded up with beer and 'smokes' for the miners. Promptly at 2 o'clock on the afternoon of the date set for the entertainment the steam was turned on, the mine-whistle began to blow, and the tooting was taken up by the whistles all over the hill. As the pumps started and water commenced to run down the mountain-side, the drinks began to flow down thirsty throats. The riotous scenes of the afternoon and evening were something to be long remembered. It is needless to say that Marshall was elected judge by an overwhelming majority, that the mine was soon pumped dry, and the long delayed dividends restored.

The fame of Leadville and the fabulous profits made by some of its mines brought into the city a continuous stream of 'tenderfeet.' While there was room for all of the miners that cared to come, the non-productive newcomers were far in excess of all possible requirements.

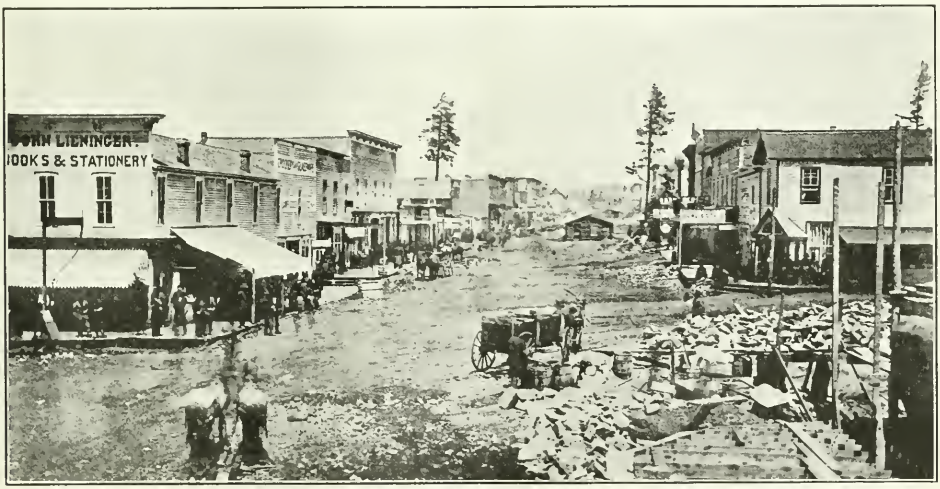
Among the young mining engineers who drifted into town about this time was one Ferdinand Van Zant, who, although he was equipped with a thorough technical education and a most pleasing personality, was unable to find engineering work of any kind. As his funds gradually dwindled, he gave up the hope of obtaining a position and began hunting for something farther and farther down the line until, ultimately, rather than allow his parents to know that he could not earn a living, he took a job as a waiter in a restaurant. One of the tables which Van Zant attended was principally used by the office employees of one of the big mines on the hill and before he had been at this work very long he one day overheard one of the men say that he wished he knew where to find "a bright intelligent young fellow who could make good figures and was accurate in his additions," for the position of weigh-master up at the mine. Van Zant immediately applied for the position and was accepted forthwith. A few months after this one of the foremen in the mine told the office-boys that he was certain there was an ore-shoot passing from the mine they were working into the adjoining claim and that if the boys would chip in together and get a lease on this claim he was certain they would make some money. The plan was carried out and Van Zant was one of the contributors to the pot. A shaft was sunk and a fine body of ore encountered. During the life of the lease the little company made a very handsome profit. At the expiration of the lease the owners of the mine refused to renew it, therefore, in accordance with the custom of the times, the lessees signalized the final division of the profits and winding up of the business by a champagne supper. At the close of the repast, when the cigars were passed, one of the party suggested that each should tell what he was going to do with his share of the profits. This was agreed to, whereupon one partner said he was going to buy a home for his mother, another that he was going to pay off the mortgage on his father's farm, the third was going to buy a herd of cattle, while still another was going to try and repeat his success by grub-staking some prospectors. Van Zant was the last to tell his plans and seemed reluctant to mention them, but on being pressed, he finally said, that he intended to go to London, rent a good suite of rooms, get a complete outfit of fashionable clothing, go into society, and marry the richest and most attractive girl he could get acquainted with. This program he carried out to the letter, marrying the daughter of Sir John Lubbock (afterward Lord Avebury). The happy couple took a wedding-tour through the United States, not forgetting to include in their itinerary the Golden West. Prospectors in those days had a habit of haunting the hotels with the hope of unloading their finds on unsuspecting tourists, and while at Butte one of these worthies drew Van Zant aside and showed him some ore from a new strike four miles from the town. Van Zant's engineering training and Leadville experience had made him a pretty good judge of minerals, he immediately recognized the value of the ore, and offered to go with the prospector to see his claim. The result was that Van Zant bought the mine and settled down to develop it.

This was the beginning of the famous Blue Bird mine, which, for many years, paid large monthly dividends with wonderful regularity.

After this had been going on for some years without a hitch, a small cloud appeared on the horizon in the shape of an apex side-line lawsuit with the Little Darling, a contiguous mine. This kind of litigation had been the curse of Colorado for some years, but this was its first outbreak in Montana. In order to obtain legal advice from experts in this type of litigation, Van Zant came to Denver and engaged the firm of Wolcott & Vaile to represent him in the coming fight. He also went to New York and secured the services of Dr. Rossiter W. Raymond, secretary of the American Institute of Mining

Engineers, as leading expert. The Little Darling owners, hearing of this, followed suit by engaging the firm of Patterson & Thomas as attorneys and myself as leading expert. The local attorney in Butte for the Little Darling mine was William Scallon, a young attorney who had just come over from the Coeur d'Alene on snow-shoes, pulling his law-books behind him on a toboggan.

The situation proved extremely complicated and one that was certainly never contemplated by the framers of the Apex Law, as, while there was a true-fissure vein in granite (aplite, to be more nearly accurate) the vein had been dislocated by a fault which gave it two parallel apices on adjoining claims, the Blue Bird and the Little Darling. By aid principally of the wonderful ability of the Little Darling company's local attorney, Mr. Scallon, secure professional advice arose from the fact that the mine-workings had already passed through the oxidized surface zone, carrying silicious gold and silver ore, down into solid sulphides carrying their principal values in copper. Daly was enterprising, far-sighted, and had abundant backing; while operating the mines he had already secured, he was continually on the look-out for other properties that might be expected to become producers or would protect him from future litigation. So rapidly did he push his various purchases and enterprises that I suggested to him one day that, owing to the irregularity of the orebodies and the difficulties of following them, we ought to have a competent geologist who would make a thorough study of the underground conditions, which was something I had not been able to find



HARRISON AVENUE, LEADVILLE, IN 1879.

the Blue Bird got the worst of it in the preliminary hearings, and, rather than allow the case to come to trial, the Blue Bird company bought the Little Darling from its owners at their own figures.

The principal owner in the Little Darling was Jim Murray, a noted plunger and a great friend of Marcus Daly. In his younger days Daly had been a working miner on the Comstock. When Butte was discovered he came there and secured the ownership of a number of the most prominent mines, which he organized into a company named after the principal mine in the group, The Anaconda Gold & Silver Mining & Milling Co., which name is still in gilt letters on one of the safes in the Anaconda Copper company's offices in Butte. Daly, through his friend Murray, probably during some of their all-night sessions at poker in the Silver Bow Club, managed to follow, with considerable interest, the Blue Bird-Darling litigation and when the final result was reached he decided to prepare for future contingencies by engaging Mr. Scallon as attorney and myself as consulting engineer to his mines. An additional inducement to time to do. His reply was simple, "Jist remember there are no strings on ye." As a result of this interview I began looking about for a desirable economic geologist and selected for this position Horace V. Winchell, under whose careful work and painstaking studies the mystery of the irregularities in the ore deposits was gradually unraveled. The geological department grew steadily in size and importance until it is now the most thoroughly organized and has the finest equipment of geological maps and sections of any group of mines in the world.

As the business expanded additional smelters were built, more mines purchased, and the entire hill hummed with ceaseless activity. Up to this time my jurisdiction was limited to the study of the orebodies and the passing of opinions on the desirability or undesirability of purchasing adjoining property. One day Mr. Daly said that the superintendents were all hounding him for more compressed air and that he had already bought more air-compressors than he had ever seen or heard of, and that he would like to know exactly how much more compressor-capacity was needed. He asked me to ascertain

this and report to him when he returned to Butte about a week later. A careful study of conditions showed that compressed air was being used for many things besides the operation of drills, such as running pumps, underground hoists, and ventilating. In addition to this, when the stopes on a level were worked out, the pipes, instead of being taken down, were allowed to remain in place and sometimes not even shut off from the main line. This was due, partly to the fact that the copper drippings dissolved away the iron to such an extent that it was rarely desirable to use old pipe unless it came from very dry workings. In addition to this the chain-gangs were exceedingly lax in tightening up leaks, a careful calculation having shown that if unnecessary waste could be prevented the mines already had more compressor-capacity than was needed. When I reported this to Daly he seemed incredulous. As the next day was 'Change Sunday' I asked him to come up to the Neversweat mine, where the principal compressors were situated, at 11 a.m. Of course, no drilling or underground hoisting was going on on 'Change Sunday,' and the superintendent and foremen were given orders to shut off all the pumps and ventilating pipes so that there would be no useful consumption of air. As the compressor-engines were fitted with indicators, it was easy to ascertain exactly the power necessary to maintain a constant pressure, or, in other words, to offset the leakage. When Daly came up to the mine and the engineers explained to him that it was taking 1100 hp. to keep up the leakage on the various pipe-lines his comments on the situation were amusing, strictly to the point, but hardly fit for publication. Next morning the chain-gangs were busy stopping leaks and the dealers in air-compressing machinery were a sadly disappointed lot.

This incident immediately enlarged my jurisdiction, one of the results of which was that we soon had a competent mechanical engineer installed, in charge of all the machinery on the mines, together with a sufficient staff to test thoroughly and bring up to the highest possible efficiency every boiler, hoist, and air-compressor on the job. Out of this work grew the necessity for a large central machine-shop where all kinds of repair-work could be carried out successfully at home. This change proved so satisfactory and economical that a central sample-grinding and assay-office was established, all of the small assay-offices at the individual mines being discontinued. This proved, if possible, even more satisfactory than the central machine-shop, for, with the power-driven grinding-machinery, it was possible to handle much larger samples and obtain more concordant results than when small samples from the drifts and stope-faces were crushed on the bucking-boards in the small assay-offices at the different mines.

Later, an unfortunate quarrel between Marcus Daly and W. A. Clark brought on a most bitterly contested mining lawsuit. The properties involved in this case were the Neversweat mine, belonging to the Anaconda group, and Clark's Colusa, two of the richest and most productive mines in the district. In this contest both Daly and Clark were intensely interested, as each considered his personal honor at stake; hence the contest was waged with greater earnestness than either of the men would ever have evinced for the mere money-value of the properties involved.

W. S. Keyes of San Francisco was given engineering charge of the case for Mr. Clark and I filled the same position for Mr. Daly, who on several occasions reiterated his old remark that there were "no strings on ye," meaning, of course, that expense was not to be considered and that the best engineering and legal talent obtainable should be engaged. This led to the engagement as attorneys for the suit, in addition to the exceedingly able legal force already in the employ of the Anaconda company, of Charles S. Thomas of Colorado and Joel F. Vaile, while, as experts I was fortunate enough to secure the services of Clarence King, N. S. Shaler, Rossiter W. Raymond, H. V. Winchell, W. A. Wiley, and E. E. Chase. We all put up at the old McDermott Hotel and were given a special table in the dining-room, where our meals, enlivened by the sparkling conversation and brilliant wit of the senior witnesses and attorneys, were a delight.

One day while puzzling over underground conditions and wandering through the workings alone, as I had done dozens of times before, I walked into some new workings on the extreme western end of the Neversweat orebody that had not yet had time to slack or cave. This showed what had been obscured in workings that were open for some time, namely, that the orebody, instead of tapering to a feather edge as orebodies usually do at their terminations, was cut off diagonally like the point of a chisel. A careful investigation showed a crack filled with finely-ground material crossing the workings diagonally. As the note-book I had with me was large enough to show both the Neversweat and Colusa workings on the same sheet, I drew with a blue pencil (from which it was afterwards named the Blue Fault) a diagonal line from the termination of the Colusa vein eastward to the western termination of the Neversweat. Of course, the next step was to go to the eastern termination of Clark's Colusa and see if anything like the same conditions could be observed there. A short investigation showed that the mysterious termination of Clark's Colusa vein to the east and the Neversweat vein to the west was probably caused by the same fault. This explanation was not immediately accepted by the other witnesses, but a critical examination of conditions in the different levels of both mines soon convinced all of them that the dislocation theory was correct. The faulting had evidently occurred before the termination of the mineralizing period, as the fault-fissure, in addition to the usual 'drag' ore, carried mineral as originally deposited. This proved the key to underground conditions at Butte, which, by the painstaking studies of the Anaconda company's geologists, has completely unraveled its mysteries and enabled them to map with certainty the position of dislocated veins.

Later, when Mr. Daly's health commenced to fail, the mines were sold to the newly organized Amalgamated Copper Company. Scallon and I were transferred with the property. H. H. Rogers, the virtual head of the Standard Oil Co., also assumed complete control of the

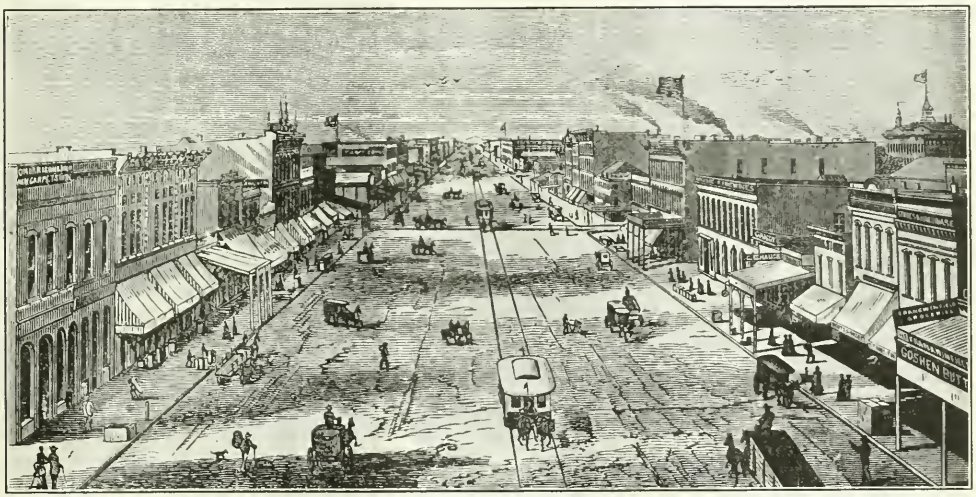
Amalgamated Copper Co., and insisted on extending my jurisdiction to include the smelters. I protested that I was not a metallurgist and that I was entirely incompetent for the work, to which he replied, "We know you are not a metallurgist, but you know more about the different metallurgists in the country than we do and all we expect you to do is to select the very best man you can find and do what you can to help him make a success of the new plant." I spent a few extremely anxious days and nights mentally weighing the experience and ability of the different metallurgists with whom I was acquainted or could gain authentic information about. After most careful consideration, I decided to offer the position to E. P. Mathewson, who was at that time in charge of the American Smelting & Refining Co.'s smelting operations in South America. The selection proved to be a most happy one for all concerned, as Mr. Mathewson's metallurgical skill, business ability, and unfailing tact have made the new smelting-plant at Anaconda not only a wonderful success, but the Mecca for copper metallurgists from all over the world.

As Mr. Rogers was heavily interested in iron mining and familiar with their economical methods of extraction, he naturally looked on copper mining costs as exceedingly high and was extremely anxious to know if some of the methods employed in iron mining could not be utilized in the extraction of copper ore. After talking the matter over, he insisted that I should visit the principal iron mines of Minnesota, where the Federal Steel Co.'s properties were situated, and familiarize myself with what they were doing. I had already seen a large number of the Minnesota iron mines but had never examined them with this specific purpose in view, therefore I was, of course, delighted at the opportunity afforded for studying their methods in greater detail.

As usual, I was provided with a private car, which was moved from one mine to another as the work progressed. The trip proved a most pleasant and interesting one, especially as I made the acquaintance of the different mine superintendents, from whom there was much to be learned.

Unfortunately, however, the mode of occurrence of the orebodies and the numerous surface improvements at Butte entirely prohibited the use of the more economical methods of iron mining, but observations on the trip fully established the desirability of back-filling stopes wherever possible. In consequence, the hoisting of waste from all our mines was discontinued and the material obtained from development was employed in back-filling.

As usual, however, Mr. Rogers' far-sighted views on the subject were entirely correct, and, while iron-mining methods are not applicable to Butte, they have since come into general use in many of the large copper mines in the United States, Chile, and Spain.



LARIMER STREET, DENVER, IN 1875.

Consulting-engineering on operations controlled by H. H. Rogers was a liberal education in itself, as his wonderful business ability and tremendous grasp of details enabled him to cover the field of possibilities so thoroughly that success in any undertaking was almost certain.

Owing to the time required to make the trip from New York to Butte, Mr. Rogers was rarely able to visit the mines, but his memory and power of visualization were so great that he had before him constantly a mental picture of what was going on in the West. Officials coming into his office from the mines and smelters were astonished to find him asking the most searching questions in the most familiar manner about everything that was going on, as if he had only visited the property a few days before. Again, the human side of the equation was constantly before him. Not only did he remember and make all his superintendents and managers feel that

he had a personal interest in them, but the health and welfare of his humblest employees were always given the most careful consideration.

How Mr. Rogers was able to carry the details of all the different lines of business in which he was engaged and keep intimate track of the widely scattered members of his staff was always a mystery to his friends, but may be partly explained by his ability to drop business entirely on leaving his office.

During the summer months he rarely remained in the city over-night, but went out to sea on his magnificent yacht, *The Kanawha*. With his wide circle of friends and lovable disposition, he generally managed to have with him some congenial company and an invitation to a trip on the yacht was something that none of his acquaintances ever declined. Among his special friends were Mark Twain and Tom Reed, who at that time was Speaker of the House of Representatives. These two intimates were usually invited together. Once when Reed had just been invited for a week-end trip on *The Kanawha*, he ran across Mark Twain and told him of the invitation before Mr. Rogers had time to invite him. Whereupon Mark Twain jumped to the conclusion that he might possibly be forgotten and sent the following letter:

"My dear Harry:

Have just seen Tom Reed and he tells me that he is invited to spend the week-end on *The Kanawha*, and I would like to remind you that a boat requires virtue as well as ballast.

Most sincerely,

S. L. Clemens."

As many a truth is told in jest, this letter was altogether too good to be lost, and Mr. Rogers immediately had it framed and hung up in his office, since, aside from the gentle thrust at Reed's ponderosity, the sentiment of the epistle was equally applicable to the conduct of human life and the management of corporations.

Venezuela has an area of 393,976 square miles, which exceeds that of Texas, Louisiana, and Arkansas combined. The population is 3,000,000, of which 73,000 is in Caracas, the capital. For twenty years a direct line of American steamers has run regularly between the United States and Venezuela, and this line has a mail contract with the post-office department, yet the steamers are said to be slower and inferior to those of the French and Royal Steam Packet lines between Venezuela and Europe. The monetary system is on a sound gold basis and no paper money is used as legal tender. All interest on the public debt has been paid promptly during the trying time of the War. For the fiscal year 1913-'14 the United States was the largest customer of Venezuela and also supplied a larger share of the imports than any other country.

The discovery of asbestos in Arizona has created interest; it is of good quality with a long fibre, being found near Globe and in the Grand Canyon. One of the largest blocks of claims was transferred recently.

Dredging in the Philippines

*Dredging was responsible for about 44% (₱1,030,000) of the total gold output of the Territory in 1914. Results of the Gumaos Placer Co., operating in the Paracale-Mambulao district are of interest. The company operated continuously throughout the year. Its dredge, built by the New York Engineering Co. has so far achieved an enviable record. On an original investment of ₱500,000, the company has paid in dividends during 27 months of operation the sum of ₱535,000, or 107%. The generally non-uniform character of the dredging ground in this district is exemplified in the record of the Gumaos dredge; the average value for different monthly runs varies from 6 centavos to ₱1.66. The average value for the whole period of operation has been 64 centavos per cubic metre. The cost of operation, according to the company's figures, is about 24 centavos per cubic metre dredged. The average fineness of the bullion is 873. The depth to bed-rock varies up to 17 metres, but has averaged about 11 metres. The gold recovered is fine and very sharp and angular. It is confined to a layer of wash usually less than two metres thick immediately over-lying bed-rock; the over-burden is largely clay. According to the general manager, Frank B. Ingersoll, the boat has yielded a total of ₱912,205 from 1,850,713 cu. yd. in 12,589 hours worked, an average of 49.29 centavos per yard. Of this, ₱380,678 was recovered from 875,303 cu. yd. in 1914.

The Paracale Bucket Dredging Proprietary, Ltd., and the Philippine Dredges, Ltd., closely associated Australian corporations, had four dredges at work during 1914. One of these started in November, and another lost a great deal of time as a result of litigation over title to the ground on which it was situated. In spite of obstacles, however, the year's record is good, and much credit is due William Telford, the general superintendent for the two companies.

The Malaguit Dredging Co. placed a new dredge on Malaguit river early in 1914. Some time has been lost in getting into proper running order, but the dredge has recovered a satisfactory amount of gold, and will undoubtedly do better later.

The Philippine Dredging Syndicate, and the Maximelo Dredging Co. each operated one dredge in 1914. About the middle of the year the former finally dismantled its old Risdon dredge, which was built in Masbate in 1905, moved over to the Paracale district in 1908, and has been digging on Malaguit river since that time.

The Mambulao Placer Co. is reported to have obtained exceptionally high gold-content from the tests of its dredging property at the head of Mambulao bay, and a New York Engineering Co.'s dredge will be erected at Mambulao during the coming year.

Several dividends were declared by the dredging companies during the past year, and the industry appears to be in a healthy condition, although more than 50% of the Philippine gold production is from quartz mining.

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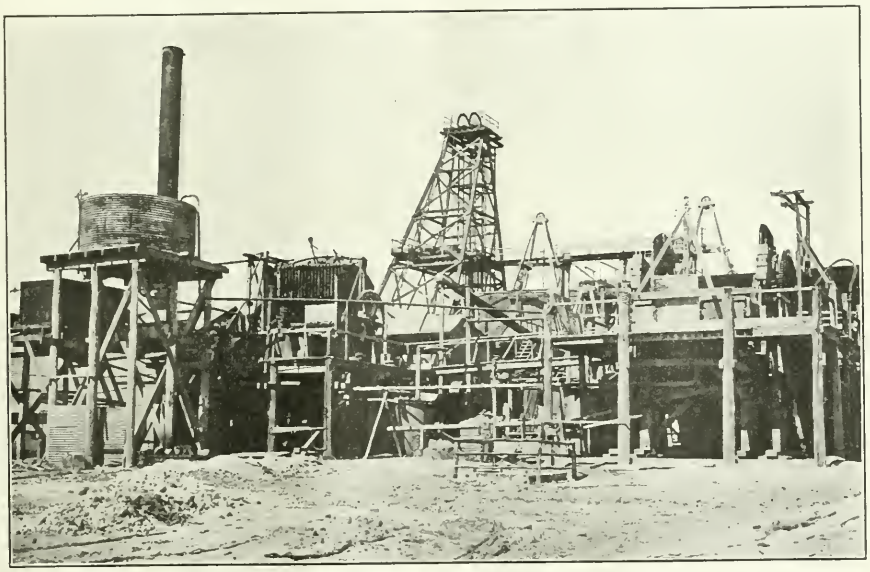
*Abstract from Division of Mines report for 1914.

Cyanidation in Western Australia

By V. F. STANLEY LOW

*The plant at the Corinthian North mine in the Yilgarn district may be taken as a fair exponent of such Western Australian practice in milling as entirely dispenses with amalgamation and employs only cyanidation for the extraction of gold from the ore.

The mine is excellently situated as regards transport, fuel, mine-timber, and water. It lies about 10 miles from Southern Cross in thickly timbered country, is served by pipe-line from the Eastern Goldfields Water-Supply, and is in direct railway communication with the capital and the seaboard.



THE CORINTHIAN NORTH MILL, SHOWING TWO RIDGWAY FILTERS.

The body of quartz that is now being extracted by open-cut methods outcrops at the surface with an average width of 20 feet. The dip is nearly vertical, inclining to the west; and the oxidized ore extends to a depth of about 90 ft. Only oxidized material is being mined and treated at the present time; but a further addition to the plant for the purpose of dealing with the sulphide ore found underneath the oxidized zone is now in course of construction. The sulphide is in the form of pyrrhotite; in order to render it amenable to profitable cyanidation the ore must first be submitted to a preliminary course of dry-crushing and roasting.

The ore from the open-cuts passes through chutes to the 100-ft. level and is trammed to the main shaft. The trucks are then raised to the brace, 48 ft. above the surface, and the ore discharged into a jaw-crusher placed immediately above the storage-bin.

The general outlay of the plant renders it eminently suitable for economical working; but the machine-shops and the main shaft have been placed too close to the open-cut and rather too near to one another, with the result that there is congestion of equipment around the shaft.

The power-plant consists of three Babcock boilers adapted for wood-fuel; these supply steam to the winding-engine, mill-engine, air-compressor, electric-light engine, and boiler-feed pumps. Approximately 186 long tons of firewood is consumed weekly in generating steam at a pressure of 150 lb. per square inch. Fouché atmospheric condensors are installed; but these may be regarded as water-savers rather than vacuum-producers. There is an adequate supply of salt water from the underground workings for all purposes other than the production of steam.

The treatment-plant consists of a jaw-crusher, ore-bin, 20 stamps, 2 tube-mills, 2 cone-classifiers, 2 centrifugal pumps (one as a stand-by), 2 thickeners, 4 agitators, 2 Ridgway filters, 2 double-ram pumps, a salt-water tank, battery-tank, solution-clarifier, 3 precipitation-boxes,

*Mining engineer, recently manager of the Corinthian North mine.

acid-vat, and the necessary furnaces for roasting and smelting the precipitated material. In addition to the above there were two grinding-pans, but, as I found upon experiment that these were serving no good purpose, they were soon eliminated.

The ore, after passing over the grizzly and through the 22 by 11-in. jaw-crusher, drops into a rectangular flat-bottomed storage-bin, 34 by 14 by 18½ ft., from which it is delivered by Challenge feeders to the 20-stamp battery.

The battery consists of four units of five stamps each, the whole being of the narrow-mortar Homestake type so often seen in Western Australia. Each stamp weighs 1250 lb., dropping 8 inches, 106 times per minute. The depth of discharge is set at 1½ in., and the order of drop is 1, 3, 5, 2, 4. The average duty is between 10 and 11 short tons per stamp per 24 hours. Screens of 17 and 16-gauge wire with 6 and 10 openings per linear inch are used, according to the nature of the ore to be crushed; but the screen of larger aperture is generally preferred. The mortars are fitted inside with liners of manganese-steel; and false bottoms are inserted from time to time below the dies in order to maintain the depth of discharge as the dies wear down.

Under normal conditions the material leaving the battery has approximately the following grading:

Mesh.	%
On 20	34
" 90	39
" 150	5
Through 150	22

Immediately upon entering the battery the ore comes into contact with cyanide solution, which is further strengthened by the addition of sodium cyanide as the pulp enters the agitation-vats later in the process. Lime is added to the ore as it enters the mortar.

The crushed material leaving the battery is conveyed by launder to a 4-in. centrifugal pump, which, working at a speed of 650 r.p.m., elevates it through a head of 27 ft. to two cone-separators, 6 ft. diam. and 7½ ft. deep.

The overflow from these cones, which is the material that eventually reaches the agitators and filters, has the following grading:

Mesh.	%
On 90	25
" 150	19
Through 150	56

It enters two circular thickeners constructed of 18-gauge corrugated galvanized iron, 25 ft. diam., the arms of which make one revolution in two minutes.

A screen-analysis of the underflow from the cones shows:

Mesh.	%
On 40	31
" 90	55
" 150	6
Through 150	8

This is delivered by launder to two tube-mills, 16 ft. long by 4 ft. 1 in. diam.; these make 31¼ r.p.m., each requiring about 40 hp. for their operation.

The liners of the tube-mills are of hard iron and are longitudinally corrugated. The discharge contains 55% of solids of the following grading:

Mesh.	%
On 40	13
" 90	60
" 150	10
Through 150	17

The discharge from the tube-mills unites with the material leaving the battery and the whole is delivered by centrifugal pump to the cone-separators, thus closing the circuit between the separators and the tube-mills.

Danish flints are used under normal conditions, but, in recent months, it has been necessary to resort to flints gathered in South Australia. These flints do the work of grinding satisfactorily, but their life is only about three-fifths that of the Danish, owing to their greater softness and liability to fracture.

The underflow from the 25-ft. thickeners is delivered to four agitators, each 18 ft. diam. and 8 ft. deep, the arms of which make 15 r.p.m. The agitators are constructed of ¼-in. steel plates and hold 57.8 tons of dry slime when the material contained has a specific gravity of 1.6. The stirring-arms are actuated by mitre-gearing through a vertical spindle 2½ in. square, which is free to move up or down through the horizontal members of the mitre-gear. The spindle and stirring-arms are suspended from an overhead frame-work by means of a chain that passes over a pulley and is attached to the upper and projecting end of the spindle by means of a swivel. After passing over the pulley the chain is led to a windlass, which stands on a platform placed on the steel tank of the agitator. By means of the chain and windlass the stirring-arms may be raised clear of such pulp as remains in the agitator-tanks when repairs to the agitator become necessary or when the plant is stopped for any considerable period. Each stirrer requires about 1½ hp. for its operation.

As the pulp enters the agitators an addition of sodium cyanide is made in quantity sufficient to leave the solution at 0.05% cyanide after agitation has been completed.

So long as care is taken to prevent the raw sulphide from mixing with the oxidized ore and entering the battery, the consumption of cyanide amounts to about ½ lb. per ton of ore treated. If, through carelessness or from any other reason, pyrrhotite is allowed to get into circulation in the plant, the consumption of both lime and cyanide is greatly increased. Under normal conditions about 120 lb. of lime is added to every ten tons of ore fed to the battery.

On the conclusion of agitation the pulp passes to a double-ram pump, which delivers it to two Ridgway filters. In these machines the filter-leaves are moved in a vertical plane through the arc of a circle from the pulp-bath to the wash-bath and reversely. Each filter contains 20 leaves, 5 ft. 6 in. by 4 ft. 2 in. over all; making due allowance for the frame-work, this gives a filtering area of 850 sq. ft. The whole mechanism, together with the pulp and wash baths, is raised to a sufficient height above the surface to allow of the delivery of the filtered

and washed pulp to a mixer 7 ft. high and 8 ft. diameter.

The pulp and wash baths are 11 ft. long, 6 ft. wide, and 5 ft. deep. Parallel with the length of the baths and mid-way between them, supported on substantial trestles, is the operating shaft, 8 in. diam. and 14 ft. 6 in. long. Worm-wheels 8 ft. diam. are keyed onto each end of the shaft, as are also radiating arms for carrying the filter-leaves and the heavy cast-iron weights used as a counter-balance against the leaves and their adherent pulp.

The leaves are attached to the arms through the agency of a hollow cast-iron girder or manifold from which 20 nipples $\frac{3}{4}$ in. diam. project. These nipples, which communicate with the hollow interior of the manifold, are placed in line along the bottom of the latter at intervals of 6 inches. Connection between the piping, which forms the frame of the leaves, and the nipples is made by means of short sleeves of rubber tubing; but the actual weight of the leaves is supported by steel rods bolted to angle-irons that project from the manifold at right angles to its length.

The manifold, where it meets the carrying arms, is circular in section and is held in bearings bolted to the arms. The leaves and manifold thus being free to rotate, the former hang vertically throughout the complete cycle of operations.

One end of the manifold projecting through the bearing is tapped to take a 3-in. gland by means of which pipe-connection is made with the vacuum-pump. Close to the gland the pipe carries an automatic valve, which is brought into operation at such time as it is necessary, during the course of filtration, to use or dispense with the vacuum.

By means of gland and piping, the opposite end of the manifold is connected with the compressed-air main. An automatic valve allows of the admission of com-

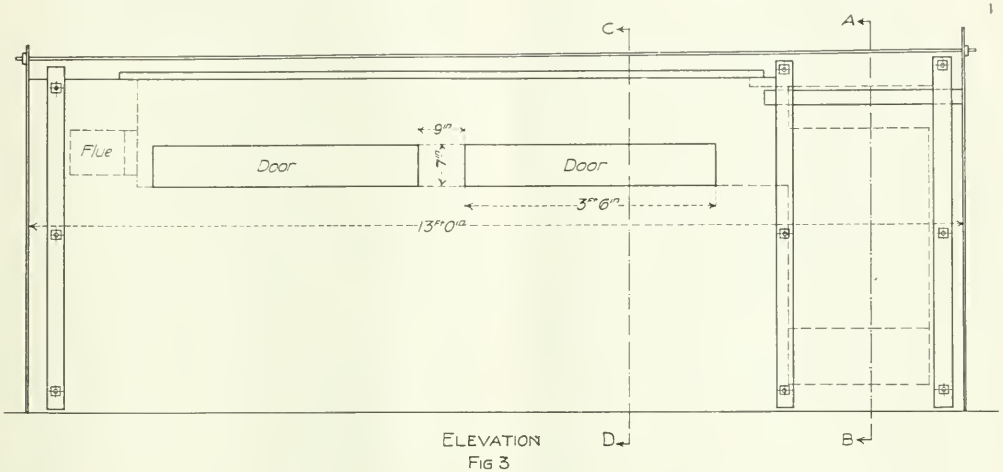
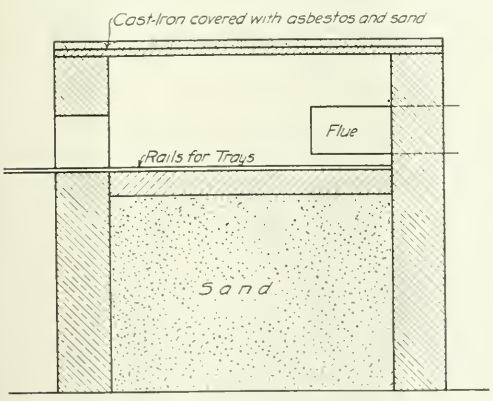
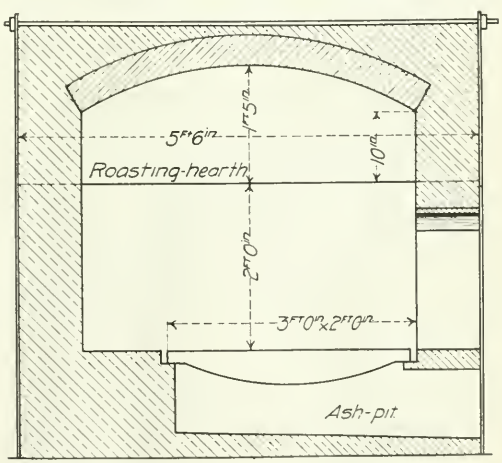


FIG 3



SECTION AT C-D.
FIG 1.



SECTION AT A-B
FIG. 2

pressed air to the interior of the leaves at the conclusion of each cycle, when it becomes necessary to blow off the washed pulp, which then goes to the residue-mixer.

A 2½-in. shaft is placed behind the wash bath and parallel with the 8-in. shaft. At each end of the 2½-in. shaft is mitre-gearing that operates the worm-gearing attached to the 8-in. shaft. The 2½-in. shaft also carries two fast and two loose pulleys with the usual striking-gear, as well as a fixed pulley for the band-brake. The pulleys are operated from a counter-shaft, one by means of an open belt, the other by means of a crossed belt; thus, by using the striking-gear and throwing either one of the belts from the loose to the fast pulley, the arms carrying the manifold and filter-leaves may be moved backward or forward as desired.

In order to prevent settlement of the solids in the pulp and wash baths, two horizontal stirring-arms are kept revolving close to the bottom of each. These are attached to spindles that enter from below and are belt-driven through interlocking cogwheels which maintain a constant position of the arms relatively to each other. The shafts, where they enter the tanks, are fitted with the usual stuffing-glands to prevent the leakage of solution.

Immediately under the 8-in. shaft, and somewhat greater in width than the nest of filter-leaves, is a steel chute for carrying away the blown-off pulp to the residue-mixer. Water is admitted at the top of the chute which it helps to keep clean and, at the same time, it dilutes the residue to the extent required for subsequent pumping to the waste-dumps.

The cylindrical mixer into which the filtered pulp passes is 8 ft. diam. and 7 ft. deep. The 4-in. spindle that carries the stirring-arms is suspended from an overhead frame-work and revolves on ball-bearings at 30 r.p.m. It is belt-driven through mitre-gearing.

After leaving the mixer the residue, now of about 1.5 sp. gr., flows to a duplex-plunger pump, 12-in. stroke and 8-in. diam., by means of which it is delivered through a 4-in. main to the waste-dumps. The size of the delivery-pipe would appear to be somewhat small; but it has been found that pipes of greater diameter are liable to clog with solidified material if the velocity of discharge becomes too low.

A double-acting wet vacuum-pump is provided for producing the vacuum, the cylinders being of 8 in. diam., 10-in. stroke, 100 strokes per minute.

The following is the cycle of operations of the Ridgway filter: Starting at that part of the operations where the filter-leaves have been raised to a position vertically above the 8-in. shaft and the cake has been blown off, the attendant now operates the striking-gear and lowers the leaves toward the pulp-bath in which they finally become immersed. The automatic vacuum-valve opens as the leaves begin to enter the pulp and the vacuum gradually begins to rise from zero, eventually reaching 20 inches. During the progress of cake formation the valve on the pulp-main is opened and thus adds fresh supplies to the pulp-bath, an overflow being provided for carrying any surplus back to the pump.

The time of immersion varies from 10 to 20 minutes, according to the nature of the pulp. With some classes of ore the time for immersion might possibly be extended to 25 minutes with advantage. If the cake be of a gritty and porous nature, a cake 1½ in. thick may be formed in 15 minutes; but by far the greatest proportion of cake is formed during the first few minutes of immersion. Should the pulp have a greasy non-porous nature, such as is common to ores highly impregnated with mica, only a thin cake will be formed, no matter how long the time of immersion may be extended. With a non-porous pulp the attendant shortens the time of immersion. It is stated that the gradual rise of vacuum from zero to 20 inches is more satisfactory for cake formation than the sudden production of the maximum.

Under favorable circumstances a cake of about five tons of dry slime will have been formed on the filter-leaves, which are now raised by the attendant through the arc of a circle and lowered into the wash-bath. As has before been stated, the wash-bath lies parallel with the pulp-bath on the opposite side of the 8-in. shaft. Throughout this transit of the leaves, which occupies about 1¼ minutes, the vacuum is maintained; it is, of course, also maintained while the leaves are in the wash-bath. As soon as the leaves have entered the wash-bath a valve connected with the sump-solution tank is opened and the bath is kept full, any surplus being carried away by the overflow-pipe. The sump-solution tank draws its supplies from the liquor leaving the tail end of the precipitation-boxes. This liquor carries gold in solution to the value of about 5 pence, or 10 cents, per ton and also contains about 0.04% cyanide. The wash-solution, after having passed through the cake on the filter-leaves, is pumped to the battery-supply tank. There is no sensible enrichment of the wash-solution during the process of washing.

After washing has taken place for 10 or 15 minutes, according to circumstances, the attendant raises the leaves from the bath to the central position immediately above the 8-in. shaft, the vacuum is shut off, the compressed-air valve opened, and the cake blown off. As the cake drops to the inclined chute it meets the stream of water previously mentioned, which carries it to the residue-mixer and, at the same time, reduces its specific gravity to about 1.5.

This completes the cycle of operations as far as the Ridgway filter is concerned. The time taken for raising the leaves from the wash-bath, blowing off the cake, and lowering into the pulp-bath is about 2½ minutes, so that, allowing for periods of cake formation and washing of 15 minutes each and 1¼ minute for the transit from the pulp to the wash bath, the cycle of operations occupies 33¾ minutes. Taking the above time dealing with a porous pulp of 1.6 sp. gr., one Ridgway filter should deal easily with 200 short tons per 24 hours.

The 20 frames that carry the filter-cloths of the Ridgway filter are composed of black iron pipe, ¾ in. diam., bent into a rectangular shape to measure 5 ft. 6 in. by 4 ft. 2 in. The ends of the pipe are united at the centre of the upper side by means of a T-piece to which the

rubber sleeve connecting with the manifold is attached. The pipe-frame is strengthened by two flat bars of steel bolted from one side to the other at right angles to the longer axis. The inside of the pipe is perforated with ¼-in. holes at 6-in. centres. As a support for the filter-cloths, which are of 19-oz. duck, a piece of coir matting is tied to the inside of each frame so as to fill the interior area. The filter-cloths, which are machine-sewn in the form of oblong bags, are slipped over the frames and coir matting; the open ends are then sewn up. Lines of stitches, uniting the two sides of each cloth and passing through the matting are then put in by hand or machine in vertical lines at short intervals. The leaves are then ready for use. The filter-cloths are removed at intervals, as required, and placed in a bath of dilute hydrochloric acid for periods sufficiently long to dissolve the soluble incrustations that have formed on them. After being thoroughly washed in water, they are again ready for attachment to the frames.

The gold-bearing solution that is drawn through the filter during caking operations is delivered to an elevated tank from which it passes through clarifying-boxes filled with wood-wool to three precipitating-boxes of the usual rectangular form. Each box has eight compartments, 22 by 34 in., and 28 in. deep, the first of which is filled with wood-wool and the remainder with zinc-shaving. The boxes have a longitudinal inclination of 1 in 30, and the solution, leaving the boxes with a value of 5 pence, or 10 cents, per ton, goes to the sump, from which it is returned into circulation.

Attached to the smelting-room are the acid-tank for dissolving the zinc, the washing-box with attachment for obtaining a vacuum, a reverberatory roaster, and a crucible furnace. Until recently the roasting was carried out in a cast-iron muffle; but as this was found slow and uneconomical a reverberatory wood-fired furnace was substituted. This has given excellent results. The furnace was built with vertical walls tied across with steel rods in the usual manner. The space between the walls was then filled to the required height with sand upon which a brick floor was formed. On the brick floor transverse rails were laid to carry removable trays; and these rails extended into the smelting-room, so that the charging of raw slime and the removal of roasted material can now be carried out with ease and comfort. The roof of the reverberatory, with the exception of the fire-brick arch, is composed of worn-out tube-mill liners resting on transverse angle-irons, covered outside with asbestos fibre and then topped with sand. The furnace is fired from the outside, so there is no necessity for the attendant in charge of the firing to enter the clean-up room.

The roasted material is mixed with the necessary fluxes and smelted in plumbago crucibles. This is a slow process, and should be replaced by tilting-furnaces such as are in general use in other parts of Western Australia.

The following is the rate of wages paid in the mining and treatment departments, being, it is evident, not much different from wages in western United States:

	Per shift.		Per shift.
Mill-men	$3.60	Blacksmiths	$4.00
Filter-men	3.20	Laborers	2.52
Engine-drivers	3.36	Miners	3.44
Firemen	2.76	Trammers	2.64

Driving, cross-cutting, sinking, and raising are done on contract at prices varying in accordance with the nature of the work to be performed, such as hardness and broken condition of the ground, extent of the opening, and general difficulties anticipated. Machine-drilling in the open-cuts is contracted for at so much per foot drilled; but the spalling and rilling of ore to the chutes is done on wages, this being found more satisfactory.

Trucking from the chute to the station and from the brace to the cracker is contracted for at 20c. per ton; and, similarly, waste is delivered from the chute to the dump at a contract price of 24c. per ton.

The costs incurred in breaking, raising, and treating 5230 tons of crude ore and in carting and treating 418 tons of dump tailing during the month of January were:

5230 Tons of Crude Ore

	Per ton.
Ore-breaking and transport	$0.64
Removal of overburden	0.14
Treatment	1.27
Realization	0.05
Management and general expenses	0.25
	$2.35

418 Tons of Dump Tailing

Treatment	$1.268
Realization	0.052
Management and general expenses	0.252
	$1.572

Total working expenditure $12,974

In addition to the foregoing, the sum of $595 was expended in development work, being equal to 5.58d. or 11.16 cents per ton of ore raised. Management and general expenses includes the salary of the general manager. The following prices were paid for the under-mentioned stores delivered at the works:

Explosives, per pound	$ 0.19
Sodium cyanide, per pound	0.22
Zinc-shaving, per pound	0.14
Borax, per pound	0.12
Flints, per ton of 2240 lb	22.24
Fire-wood, per ton of 2240 lb	1.62
Lime, per cwt. of 112 lb	0.67
Battery shoes and dies, per cwt. of 112 lb	7.98
Wire-screen, per roll	36.00
Water, per 1000 gallons	2.40

From the statement given above it will be seen that the cost of production amounted to 2s.7.8d. or 63.62c. per ton of ore and the treatment 5s.3.43d. or $1.26 per ton, the final total cost amounting to 9s.9.73d. or $2.35 per ton of ore raised and treated; while the cost of loading and treating tailing that had accumulated during the earlier history of the company prior to the introduction of cyanidation amounted to 6s.6.65d. or $1.57 per ton of tailing. Costs of production and treatment are calculated on a basis of 2000 lb. per ton.

The Electrical Theory of Flotation

By THOMAS M. BAINS, Jr.

Introduction. If one turns to 'Elementary Lessons in Electricity and Magnetism,' by Silvanus Thompson and studies the fundamental principles of frictional electricity, as given in Chapter 1, a clearer idea of the causes of 'flotation' may be obtained. After seeing a few experiments, such as were performed at the Case School of Applied Science early in the year, it is not a difficult matter to believe that most of the phenomena are electrical in nature. For instance, if powdered galena ore, with a limestone gangue, be dropped into pure water, most of the powder will immediately sink to the bottom. As the air enclosed by the particles is expelled gradually, one sees the formation of 'armored' bubbles, some of which may last for days. Here is flotation without oil or acid. If nitric acid is added, the gas bubbles formed by the action of the acid on the gangue, will carry up particles of galena, some reaching the surface and bursting, while others too heavily loaded with galena particles will hover just below the surface. These will form clusters, resembling bunches of grapes, and when enough gas bubbles join the clusters, they start upward toward the surface, but generally before reaching there they are overloaded by particles falling from the bubbles that are bursting at the surface. The bubbles with their loads often resemble balloons, with the galena hanging on to the bottoms, as do the baskets of actual balloons. Some of the bubbles will be completely 'armored' while others will be nearly free from galena. Another experiment that may be successfully used in the laboratory for the flotation of the difficult sulphides, such as old rusty pyrite concentrate, like sweepings from floors of old mills, is as follows: Mix the ore with bleaching powder, some carbonate (say, sodium carbonate), and water. Put the mixture into a glass beaker and add concentrated nitric until red nitrous fumes are given off. Chlorine also will be evolved. The bubbles of gas are so highly charged electrically that pyrite from the Mother Lode between 10 and 20-mesh size was floated, making a complete separation from the quartz gangue. In this experiment the nitrous oxide was the active agent, for if the same experiment is conducted with sulphuric acid, no such separation takes place. Assayers are familiar with a similar phenomenon when treating blister copper with concentrated nitric acid and heating. Nitrous oxides are formed and the metallic copper is floated, a froth of copper being the result. Carbon dioxide does not seem to be as active as the nitrous oxides or chlorine bubbles.

Electrification of the Bubble. Two different substances, whether gaseous, liquid, or solid, when brought intimately into contact and moved one over the other, always produce electrification. Difference of temperature of two similar substances in frictional contact will cause electrification, the warmer usually being negatively charged. Something certainly happens when the surfaces of two different substances are brought into intimate contact, for the result is that when they are drawn apart, they are oppositely charged. The nature of the charge depends on the substances. Fur rubbed on glass electrifies the glass negatively; while if glass is rubbed with celluloid it will become charged positively.

A blow struck by one substance on another produces opposite electrical states on the two surfaces. Again, the evaporation of liquids is accompanied by electrification, liquid and vapor assuming opposite charges, though this is only apparent when the surface is in agitation. A few drops of copper sulphate thrown on a hot platinum plate produces violent electrification, as the copper sulphate evaporates. Electrical charges are set up by various other means, such as vibration, disruption of material, crystallization, combustion, pressure, and chemical reactions.

It would seem easier therefore to electrify a bubble than to keep it from being electrified. I assume that the bubbles are electrified, whether by means of air being forced through canvas, by beating air into water with blades, or by other means. The next step is to consider the properties of an electrified sphere. These may be illustrated by suspending two light spheres of conducting materials near each other by means of silk threads. Upon charging the spheres with like electric charges, they will repel each other, but if a conductor is brought toward them, both are attracted to the conductor. Of course, if the spheres touch the conductor and the conductor is grounded, then the spheres lose their charges. If the conductor is insulated from the ground, then upon contact with the spheres, the conductor receives a similar charge and the spheres will be repelled. Suppose that the spheres or conductor are covered with an insulating film. Then the spheres and conductor would remain as close together as the films would permit. So air bubbles that are electrified will attract conductors near them that are free to move. Air, being a poor conductor of electricity, the bubbles as a whole do not discharge immediately upon contact with a conductor. The only part of the surface discharged is that in immediate contact with the conductor, and this discharged film of air acts as a dielectric and non-conductor to the rest of the bubble, which remains charged for some time.

The amount of electrification of the bubble will depend on various conditions, such, for example, as the amount of friction produced by the blades of a Minerals Separation machine. Increase the speed and the electrification is greater and the attraction for conductors will increase, reducing the proportion of conductors in the tailing. Referring to the *Mining and Engineering World* of Janu-

ary 17, 1914, page 99, the speed of agitation and the percentage of extraction is given as follows:

Speed of blades, r.p.m.	Extraction. %	Weight of product. Gm.
1800	68	39
1200	54	32
900	46	26
600	39	18

The extraction seems to vary directly as the square root of the increase in speed. But it will be observed that with the increased extraction, the percentage of sulphide in the concentrate decreases, due to the attraction of the small particles of mixed gangue and sulphide. If the bubbles are highly charged, the concentrate will not be as clean in a particular case, as if they were less charged.

Vapors and gases may be highly electrified. The Armstrong hydro-electric machine, devised by Lord Armstrong, gave sparks of 5 to 6 feet. The friction of a jet of steam through a wooden nozzle generates the charge on the particles of condensed water in the steam. Gases derived from chemical reactions are also often highly charged, such as the nitrous oxides in the above experiments.

Relative Conductivity. From the above, it appears that to float a mineral, it must be a conductor. The following table of relative conductivities is taken from Landolt-Bornstein 'Physikalisch-Chemische Tabellen,' 1912, fourth edition:

Silver	681,000	Pyrite	41.7
Copper	634,000	Magnetite	1.24
Gold	455,000	Chalcopyrite	0.983
Iron	113,000	Manganese di-oxide	0.16
Covellite	8,000	Cuprite	0.025
Galena	3,350	Siderite	0.00014
Graphite	700	Quartz	0.844×10^{-14}
Pyrrhotite	119	Diamond	0.211×10^{-14}
Chalcocite	91		

From this table, it would seem that the metals and sulphides that may be recovered by the flotation method are all conductors. The chalcopyrite figure seems low, but the flotation properties of sulphide minerals vary, and the variation in the conductivity of the different minerals may have something to do with this. The better the conductivity of the valuable mineral, the easier is it floated, other factors remaining the same.

The Insulating Film. The next important question in the problem is the action of the oils, resins, or other agents now used in flotation. Working from the electrical standpoint, it is necessary to prevent the charge of the bubble from being dissipated and thus breaking down the froth, before it is desired. Oils and other substances have a tendency to coat the metals and minerals that are recovered by flotation, and if the air bubble is completely surrounded by these particles, an envelope of oil or other dielectric will insulate the bubble and prevent the dissipation of the charge. Without a dielectric film about the bubble no permanent froth would be formed. It is, therefore, necessary to add some material of great dielectric strength that has the tendency to coat the valuable mineral.

The words 'dielectrics' and 'non-conductors' or 'insulators' should not be confused. A 'dielectric' is a substance that is not only a non-conductor, but is also one that takes part in the propagation of the electric inductive forces. All dielectrics are 'insulators,' but equally good insulators are not necessarily equally good dielectrics. Air and glass are far better insulators than ebonite or paraffine, but the inductive influence acts more strongly across a slab of glass than across a slab of ebonite or paraffine of equal thickness, and better still across these than across a layer of air of the same thickness.

It may, therefore, be possible to use a frothing agent, as is well known, that is not an oil at all. I have done this and formed froth that has lasted for weeks. For instance, if in the experiment mentioned in the first part of this article, with galena ore, a little alcohol is first mixed with the galena, before the water and acid is added, then a heavy mass of bubbles and galena particles will be formed, too heavy to rise to the surface.

As the influence of the charge acts inversely as the thickness of the film, it is imperative that some dielectric be used that will create a very thin film about the valuable mineral. The dielectric must also be of such a character as to aid the formation of a great quantity of small bubbles in the liquid. It is difficult to create and maintain small bubbles in pure water. It is here that surface tension phenomena probably play a part in flotation.

Acidity of the Pulp. In D. G. Campbell's article in the *Mining and Engineering World* of January 17, 1914, he gives the following results of acid variations:

Acid, Gm.	Extraction, %	Weight of product. Gm.
0.0	63	67
0.2	50	60
0.4	51	35
0.4	48	30
0.8	40	26

Other tests also show that the extraction decreases as the acidity increases, but the amount of gangue in the concentrate decreases much more rapidly. With an acidified pulp, a cleaner concentrate is obtained. Also better results are obtained if the acid is added before the oil to the agitation-tank.

As to the action of acids and alkaline substances in the pulp, little seems to be known, but according to the electrical theory, the addition of these substances causes the conductivity of the pulp to increase greatly. It is a possibility that if the acid is not added before the oil, that the gangue, oil, and conductors are all electrically charged by reason of the friction. The conductors would be positively charged, while the other substances and the air bubbles would be negatively charged. If the pulp is a poor conductor, as it would be if water is not acidified or otherwise made a conductor (pure water being a very poor conductor), the charges on the gangue materials would remain for some time and the conductor (sulphides, etc.) would attract the gangue as well as the bubbles and oil, thus causing gangue to be taken up with

the bubbles. By the addition of acid, the charges on the surface of the solids are discharged to the ground, and the bubbles and the oil, which will not be instantly discharged as are the solids, will attract the conductors.

Conclusions. It might be stated here that the electrical theory was taught last year, as possibly explaining flotation phenomena, to the class in ore-dressing, at the Case School of Applied Science.

The above mentioned method of floating conductors may be used for the rapid determination of certain ingredients in ores that are amenable to the flotation process. It requires only a beaker and a few chemicals, no flotation machines being needed. For the rapid approximate determination of insoluble in a smelting ore, the method will give a fair result within a few minutes. If the conductor is readily acted upon by nitric acid, the results may not be satisfactory, but by addition of oleic acid the dissolving action of the acid is reduced.

The following summary of the requirements for 'flotation,' considered from the electrical standpoint, may be of practical use:

1. Ores containing valuable minerals or metals that are good conductors are the only ones that are suitable for flotation.

2. To buoy these conductors, it is necessary to supply enough electrified bubbles from below to float particles of the conductors that are attracted; hence the smaller the bubble, the better the result, the amount of gas being the same.

3. Some dielectric fluid is necessary to cover the conductor or the bubble, to prevent the dissipation of the electric charge. The thinner the film of dielectric and the greater its dielectric strength, the greater the effective attractive force and the more permanent will be the froth.

4. Some material must be added to the water to increase its conductivity, to obtain a clean concentrate; acids in small quantity are now used.

Pulmonary Disease Among Joplin, Missouri, Miners

*The conditions of working in the zinc-lead mines of the Joplin district have been thoroughly studied by A. J. Lanza and Edwin Higgins, who make the following conclusions and recommendations:

Conclusions. 1. The death rate from pulmonary diseases is unusally high among the miners of the Joplin district.

2. Poor housing, exposure, alcoholism, the use of common drinking receptacles, and overwork all tend to spread infection and lessen the power of the miner to resist disease, but the prime factor in causing pulmonary trouble is the rock-dust in the mines.

3. Rock-dust in the sheet-ground mines, although not made in great quantity, as compared to mines with more restricted working places, is harmful to the miner for two reasons: (*a*) because he is exposed to it practically during his entire shift, and (*b*) because the dust is made up chiefly of particles of insoluble flinty chert with splintered and knife-like edges.

4. This rock-dust is produced by the blowing of dry holes, squibbing, boulder-popping, drilling without water, shoveling, tramming, roof and pillar trimming, and the dumping of the bucket at the surface.

5. Certain precautions will abate the rock-dust.

Recommendations. 1. The following means should be employed for the abatement of rock dust in the mines:

(*a*) Provide a water-supply for every working face by the laying of a separate water-line.

(*b*) Where drills are operated without water, attach to the hose leading to the face a 5 or 6-ft. length of pipe with a nozzle from ½ to ¼-in. diameter. Make and enforce such regulations as will ensure the use of this water-spray for the purpose of wetting drill-holes, the face, and the broken rock about the face. For the purpose of washing drill-cuttings from drill-holes, this hose may be attached to the long pipes now in use for blowing out drill-holes.

(*c*) Where there is in use some type of drilling-machine that provides for water passing through the core of the drill-steel into the drill-holes, make and enforce regulations that will ensure the spraying of the face and broken rock for short periods at such times as the drill may not be in operation. For this purpose the water-hose must be uncoupled from the drilling-machine, unless separate water-connection is provided.

(*d*) Make and strictly enforce rules against squibbing and boulder-popping while the shift is underground, and against the blowing of dry holes at all times.

(*e*) Improve ventilation by the opening of new shafts whenever practicable.

2. Do away with common drinking-cups and kegs, and water-pipes which allow the miner to bring his lips in contact with the orifice. Substitute the well-known sanitary drinking fountain when practicable, or have miners bring their own water-supply in individual containers.

3. Do not employ as shovelers men under 20 years of age.

4. Through co-operation among the operators, provide a maximum daily tonnage for shovelers, so that they can not injure their health through overwork.

5. Provide a warm, dry, and clean place in which the miners may change their clothes.

6. Through intensive educational campaigns in the public schools, and among the miners themselves, disseminate information as to the harmful effects of insanitary practices and conditions, such as crowded living quarters, overwork, exposure, dissipation, the breathing of air polluted by powder-fumes and rock-dust, and the use of common drinking devices.

*Abstract from *Technical Paper* 105, of U. S. Bureau of Mines.

Plain Writing

By GEORGE OTIS SMITH

*Two years ago I spoke to the American Mining Congress on the subject 'Plain Talk'—both preaching the use of direct statement and trying to practice what I preached. Of late, my thoughts have turned more and more to the need of the use of popular language in stating technical results; hence this afternoon I venture to discuss plain writing from the standpoint of a Government scientist. For twenty odd years my association with scientists has been fairly intimate and though I may not qualify in plain writing myself, I can claim large acquaintance with both the written and the printed page whose meaning is far from plain.

At its best, science is simple; for science is not much more than arranging facts so as to set forth the truth. Scientific thought is exact and direct; and scientific writing must therefore be accurate and to the point. The scientist should think directly and with the precision of one of the instruments of his trade, and above all his language must present that thought exactly.

In scientific writing, this need of exact statement has led to the use of special terms, words that keep their razor-edge because used only for hair-splitting distinctions. In a certain degree this adoption of words not commonly used is unavoidable and therefore defensible. Yet, in many instances the practice is carried to an extreme and far too often the result is a highly specialized language so distantly related to our mother tongue, that as a preliminary qualification the writer has to pass a civil-service examination and the reader usually finds himself 'shut out' and facing a 'No Admittance' sign unless he happens to possess the degree of Doctor of Philosophy.

Mind you, it would be folly to throw away these tools so well fitted for special purposes, yet it is no more the part of wisdom to put them to every-day uses. The task for the scientist is to decide when to use his technical terms and when to talk United States. Of course, any writer's first duty is to be intelligible. Choice of language thus resolves itself largely into an understanding of the audience. If a scientific investigator desires to announce his discovery to his fellow-workers, he does well to use those exact terms that carry the same shade of meaning the world over and indeed may have the same form in several languages; if on the other hand, his results have immediate value for the mine-operator or the prospector, the geologist does not and cannot accomplish his purpose unless he writes in plain language, using words possibly less exact but surely more understandable.

It may be, I have stated the case too simply, so that this matter of plain writing may seem altogether easy, yet making out the prescription is always much easier than effecting the cure. Indeed, I suspect the difficulty is largely an internal trouble with the author, so deep-seated that my simple prescription of fitting the language to the reader does not reach it.

Sir Clifford Allbutt in his 'Notes on the Composition of Scientific Papers' lays down the plain rule: "Take pains therefore, with yourself first, then with your reader." His idea that clear thinking must be the first step to plain writing, of course deserves our endorsement, based upon experience. How common is the sad discovery that a piece of obscure writing is simply the product of roundabout reasoning or twisted thinking. Printer's ink unfortunately possesses no magic properties as an agent for clarifying muddy thoughts. Yet, no doubt it sometimes happens that some of us try to cover up with long words our uncertainty in thinking. So in preaching reform in scientific publications, those of us who are doing the work must realize that plain thinking comes first. There's the rub!

It is therefore not a coincidence that some of the deepest thinkers in geological science have also possessed a literary style conspicuous for clarity of expression. On the other hand, some authors whose English needs the most editing are equally careless in their quotation of facts determined by others, and indeed in the statement of their own observations. I mention this simply to show that I am strong in my belief that plain writing is not something beneath the plane of endeavor of the scientific investigator—indeed, it is something to attain which the most of us need to aim high—to raise our standards of scientific thinking. The use of common words is worthy of any writer, if his purpose is to transmit thought.

The discussion of plain writing at this time is not academic, because my real purpose is to take this opportunity to announce to you the policy of the United States Geological Survey on this subject. Our explorations, surveys, and investigations are in the public interest only as results are made public. This policy is as old as the Geological Survey itself, but several things have given a special impetus to the development of this policy. Beginning in August a year ago, a large volume of inquiries from producer and consumer of minerals came pouring into our office and as never before the Geological Survey became a kind of 'Central' to the mineral industry. This opportunity for a larger service to the public not only resulted in gratifying relations with a large number of correspondents, but the rendering of such service has proved instructive to the public servants charged with the duty. Many of us on the Survey staff have acquired a keener realization of the need not only of giving the public the facts, but also of making those facts intelligible and useful to the citizen who may lack professional training in geology or engineering.

Another line of larger service has been the issue of four guide-books to this great Western country, in which the purpose has been to inform the traveler concerning the resources of this part of our country as well as to unfold to him in attractive form its fascinating geology. The effort to meet the public need of authoritative information of this type seemingly has met with success,

*An address delivered before the American Mining Congress, at San Francisco, September 22, 1915.

and other guide-books in this series will follow in other years. More than that, however, the influence of this innovation is already felt, and the evident appreciation by the general public of this type of popular description is encouraging the Survey writers. The educational responsibility of this Federal service is being more fully realized and we intend to give much more attention, both to the simplification of the language of the professional publications and to the issue of reports that are popularly descriptive and instructive without loss of exactness. Even if plain language is used, our reports should be no less efficient vehicles for professional discussion or for announcement of geologic discoveries.

For thirty-six years the United States Geological Survey has reached an ever-widening circle of readers, and even in those first years of the Survey's life, King and Emmons and Gilbert gave to the West the results of their work in strong and forceful English. Yet, with the growth of the organization and the development of the science, the tendency toward highly specialized writing has been too marked and the present plea for plain writing has become necessary. The Government scientist has at least two obligations: first, that of making his investigations more and more exact in method and direct in result; second, that of making his product, the written report, such as to meet the needs of not only his professional associates but also the general public.

It is our ambition that the reports of the United States Geological Survey shall be written in the language of the people.

Precipitating Action of Carbon in Cyanide Solutions

By W. B. BLYTH*

†Graphite under suitable conditions will act like oil in the flotation process, and will selectively float certain finely-divided mineral particles. This factor must be taken into consideration when assaying the graphitic scum which appears on the surface of the pulp, or else an erroneous impression is likely to be formed as to the causes which tend to make this scum assay so high in gold.

In at least two cases known to me this factor satisfactorily explained the high assay-value of the scum, and showed that it was not due to premature precipitation caused by the graphite. In one case in roasting 'scum' from a Kalgoorlie plant, some sulphur was observed to be coming off. An analysis was made, and it was found that the sample contained both iron pyrite and tellurium. As all the gold in this ore was associated with the pyrite and tellurium, the presence of both in the scum was sufficient to account for its value. On another occasion, while investigating the treatment of an ore that contained both graphite and mispickel, and in which all the gold was associated with a small proportion of mispickel, the graphitic scum was found to be largely comprised of this mineral.

Unfortunately, the records of experiments made at the time are not now available, so exact data cannot be given.

Last year I was engaged in elaborating a scheme for the treatment of an ore containing much graphite and mispickel. Concentration tests showed that a large proportion of the quartz could be reduced to such a low value that it could be discarded direct; also, that the mineral in the slime could be readily floated off, and that this mineral (owing to the graphite) would float just as well without as with the addition of oil as a floating medium. Unfortunately, the froth in both cases was too bulky for the process to become commercially applicable.

Mr. Feldtmann's experiments are quite conclusive as regards the precipitating action of graphite (or the precipitating agents) contained in the West African schist, but in view of all the conflicting evidence that has been brought forward and published in the technical press during the last decade, we seem to be as much in the dark as ever as to why graphite *per se* precipitates gold. In some cases the result is due to contained occluded hydro-carbons, or some other carbonaceous matter associated with the graphite, while in other cases these factors are absent and the cause of the phenomena is not apparent. Unlike E. S. King, I have never been able to prove that West Australian samples of this variable member of the carbon family do precipitate gold.

Experiments have been carried out on Kalgoorlie Laverton, Murchison, and Southern Cross ores with negative results; in fact, in some cases when the samples contained a little gold, the pregnant auriferous solution was found to have increased in value during eight hours' agitation. From the mass of evidence brought forward it seems proved that pure clean massive graphite will not precipitate gold. As instancing this point there is one mine at Kalgoorlie where all the old plumbago melting-pots are regularly ground in a ball-mill and amalgamated, agitated with cyanide solution, mixed with the current slime, and filter-pressed. The metallurgist in charge of this plant assured me that a good extraction was obtained and no harmful effects were noted.

The effectiveness of graphite as a flotation medium is largely dissipated upon roasting, but if the roast is bad it will still be capable of acting in this manner.

The reason why the gold cannot be dissolved out of this selectively-floated mineral, is probably that the greasy graphitic scum effectively insulates the gold particles from the action of the cyanide solution.

*Formerly with Bewick, Moreing & Co., Kalgoorlie, Western Australia.

†Excerpt from Bulletin 132, Inst. M. & M. Discussion on original paper by W. R. Feldtmann.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

FRICTION OF WATER in pipes increases as the square of the velocity of the water.

FROM EXPERIENCE with tread-mills in British prisons, it has been learned that it would require the work of 40 men of 150 lb. each to develop one continuous horse-power.

MINERAL EXPORTS of Peru include the production of Bolivia, the adjacent republic, so that the figures given on page 622 of the PRESS of October 23, for Peru, will be properly understood.

METALLIC MAGNESIUM, it is claimed by scientists, can be substituted for aluminum, and for serving as electrical conductor an alloy of magnesium and aluminum is said to be commercially practicable.

MINE TIMBER should have the bark stripped off before being shaped and put in place. By hand a man can peel up to 60 logs per day, but by using a pneumatic hammer with suitable chisel up to 200 per day can be done. When the bark is removed rotting can be detected.

TAKING the population of the world at 1,732,000,000, the average use of copper per capita per year is 1.3 lb. Europe is using an average of 3.1 lb. per capita per year, North America 6.2 lb., United States 7.7 lb., while Africa, Australia and Asia combined use only about 0.008 lb. per capita per year.

AIR-BLASTS are generally associated with underground work, but an accident to the aerial tram at the Tomboy mine, Telluride, Colorado, early this year, was attributed to a snow-slide that came down the mountain on the side of the canyon opposite the tramway, and, mainly by force of the accompanying air-blast, destroyed and carried away two cable-towers.

THE COST of producing an ounce of gold at well-known gold mines is given as follows: Alaska Treadwell $11.85, North Star $11.08, Yuba dredge $6.26, Camp Bird $7.65, Portland $15.94, Homestake $13.72, Goldfield Consolidated $11.93, East Rand Proprietary $13.41, Mysore $8.39, Sons of Gwalia $14.84, Waihi $12.20, Yukon Gold (Dawson dredging) $9.76. The figures do not include any amortization nor interest on principal, and are not all for the same financial year.

NAMES of many minerals have the termination 'ite,' and a correspondent wishes to know its meaning. According to Dana the ending 'ite' or 'itis' (the original of 'ite') was used, according to system, among the Greeks, and adopted from them by the Romans, for the names of stones, it being one of the regular Greek suffixes. It was added (as 'ite' at the present day) to the word signifying quality, constituent, use, or locality of the stone. In 1783 Werner introduced personal names into mineralogy; these also have the suffix 'ite.'

BALL-BEARINGS are now made of chrome steel, as are some roller-bearings. This steel contains 1.3 to 1.6% chromium, besides small amounts of carbon, manganese, and silicon; phosphorus and sulphur being detrimental should be less than 0.02%. The balls or rollers should be absolutely uniform in size. In ball-bearings a slight difference in the size will cause the larger balls to take more than their share of the load, tending to deformation, while the smaller balls will be compelled to slide, resulting in breaking or flaking of the balls and raceways.

CONSTRUCTION of mine plants is fruitful of many accidents. This is due, primarily, according to the Anaconda company's publication *The Anode*, to the fact that the conditions under which the work is done are constantly changing, and that it is generally impracticable to make the working places as safe as they would be made under more stable conditions. Another matter that has a great effect upon the number of accidents that happen is the fact that most construction work is a rush job. Foremen and men get out to break records and are keyed up to work at the highest rate of speed, so that the taking of a chance that might cause an accident becomes a matter of comparatively slight importance to them. Among the most important causes of such accidents are: improperly built scaffolding, holes in floors that allow men falling through, loose material falling on men below, hoists not properly guarded, careless handling of electric wires that may interfere with construction, bad slings and tackle, and heavy materials slipping from tackle.

LOCATION of a mining claim is not valid unless based on a mineral discovery within the lines and on the actual ground of the claim, although it is known that a large number of locations are made without mineral discovery. It has been held by the Land Department at Washington and by many courts, that "a valid location of a mining claim may be made whenever the prospector has discovered any indications of mineral, so that he is willing to spend his time and money following it with the expectation of finding ore." Applicants for mining patent have their ground examined by a Federal Government mineral examiner. The position of a locator attempting to hold a location without a mineral discovery cannot be fully defined. The locator is entitled to be protected in his occupation of the ground, especially while trying in good faith to make a mineral discovery. Under the law, other locators are also entitled to go upon the ground, so long as it can be done peaceably and without interfering with the first claimant, and under such conditions to attempt to make a discovery. In the case of these rival claimants, the claim goes to the one making a discovery first.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

ATOLIA, CALIFORNIA

THE TUNGSTEN SITUATION: PLACER WORK, LEASING, PRICES.

Continued activity marks developments in the most prominent tungsten area of the United States, namely, Atolia in San Bernardino county. The influx of population continues, and it is estimated that there will be a population of 1000 here next spring.

Production of placer scheelite is increasing, and where only a half dozen 'float' diggers were busy in October, there are now 30 at this work. The 'potato patch' is producing daily from 250 to 400 lb. of high-grade (almost pure) scheelite, also about a ton of lower grade. The workmen, mostly foreigners, get $3 per day of eight hours. The high-grade is crushed and dispatched with the regular shipments of concentrate made by the Atolia company.

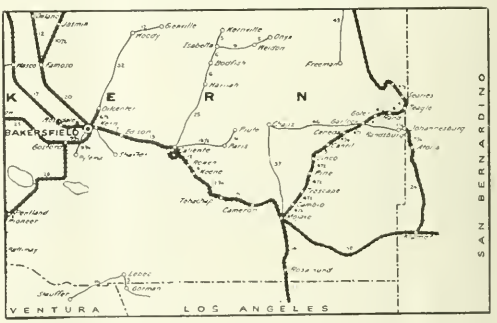
There is a noticeable gain in scheelite production from the 'stringer district,' where both quartz and placer scheelite has created a stir. Nearly 100 men are employed in that area, mostly lessees, who pay as high as $1 per foot for squares of ground averaging 250 ft. of surface. The mineral found is smaller, but the particles are quite as rich as those of the potato patch, four miles south-east.

On the road to Randsburg, and 2½ miles from Atolia, a well known miner named Bob Tate has discovered a small promising, high-grade scheelite vein, which proves that the area of the tungsten belt, in Rand district, is fully six miles long and three miles wide. Engineers who have examined the geological formations of Kern and San Bernardino counties, agree that recent discoveries warrant the prediction that there is a granite belt 30 miles long, extending west from Hinckley on the Santa Fe railway, near Barstow, to Kelsey creek, which gives promising prospects of scheelite, wolframite, ferberite, hübnerite, and even molybdenite. No commercial production of any of the last named are reported so far, but a grayish specimen from the properties recently discovered by Mayhood and Fellman, near Jawbone canyon, is about 40% grade, which shows a mixture of scheelite with a darker mineral, which is probably hübnerite. A mill has been erected on this property, and crushing and concentration of the ore has already begun. Shipments will necessarily include a haul by auto-trucks of 32 miles to Cinco, a station on the Southern Pacific branch, to Owens river. Several Atolia miners have migrated to the new centre with prospects of leasing.

Among new lessees in the Atolia district, are Jim Burns and Dan Connors, who have begun development of Andy Nixon's White Flower claim. C. B. Raymond is a new lessee of Scheelite No. 6, an east extension of the Osdick claims about a mile east of the new Atolia mill. Work here is deep, there being from 20 to 40 ft. of overburden, combining stream-wash, lava, and 'malapai,' before the granite bed-rock is reached. Driving on bed-rock, however, is productive of high-grade scheelite in placer form. A few feet of driving frequently more than pays for the extra cost of sinking. Carl Mengel and A. Kazamoat secured over 500 lb. last week, after striking bed-rock at 30 ft. The large pieces were sharp and angular, showing that the source of this deposit was not far distant. About a score of lessees are now operating on the Osdick properties, on the flat between Atolia and Cuddaback lake.

The recent completion of a new 30 by 60-ft. lodging-house at Atolia has again been augmented by an order for 36 more tent-houses, to accommodate the additional population of the camp. There are now over 250 men on the Atolia Mining Co.'s pay-roll, besides those employed elsewhere by lessees and placer miners. Whereas the pay-roll in 1914 was less than $4000 per month, at present it is over $35,000. Production has increased from 8 to nearly 100 tons per day.

Messrs. Brock and Lypp, successful lessees on Osdick's Skylark claim, sold 13 tons of concentrated scheelite to the Atolia company on November 9; the price stipulated was $42 per unit of 60% WO_3, or better. It is estimated that this lease will net the holders over $200,000 each, before next May, if present prices for tungsten prevail. Prices for placer tungsten dropped



MAP SHOWING THE TUNGSTEN DISTRICT OF ATOLIA.

at Randsburg, and sales were made at $38 per unit by the usual buyers. A further decrease is predicted, as future deliveries cannot be contracted for beyond a few days at a time.

D. Atkins, of Atkins, Kroll & Co., San Francisco, managers of the Atolia properties, was here on November 12, on a tour of inspection, which included an ore-shoot from the Churchill mine No. 1. This ore came from a shaft that is now down over 1000 ft., with good pay ore still going down.

SONORA, CALIFORNIA

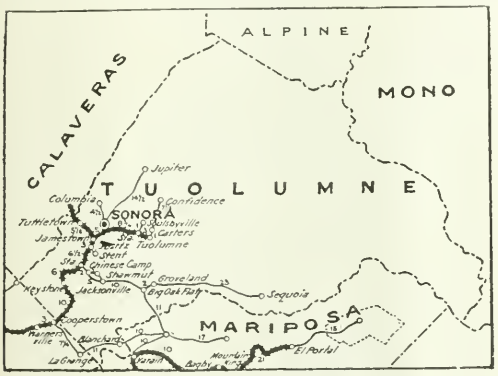
REVIVAL OF MINING IN TUOLUMNE COUNTY; NEW CAPITAL FOR OLD PROPERTIES, AND MORE DEALS PENDING.

It may be said that the outlook for a general revival of activity in Tuolumne county's mineral area is better to-day than at any time in the past 20 years. Capital is seeking investment here in a large as well as a small way, and some of the former mines of note are being re-opened. Within the past month three large Mother Lode properties have been sold under bond, and are being energetically developed. The old Rawhide, a rich producer 20 years ago, is now in the hands of the Silver Peak Mining Co., of Nevada. John Moicene is directing the work of resuscitating the Rawhide, and as soon as the mine has been unwatered, the shaft, which is down 1700 ft., will be sunk to greater depth.

At the Dutch, Sweeney and App, recently acquired by W. J. Loring, of the firm of Bewick, Moreing & Co., of London, a vigorous underground campaign has been started to uncover at a greater depth extensive and rich orebodies which were found and worked out in the upper levels. Great improve-

ments to the surface equipment is being planned, which will be made just as soon as development in the mine warrants them. Mr. Loring feels confident that he will obtain gratifying results in the Dutch-Sweeney-App property. To a representative of the PRESS on November 12, Mr. Loring stated that his English associates are not connected with him in his Tuolumne county enterprise, on account of the War; American capital which Mr. Loring personally interested in the East, is behind the scheme.

The Republican group of five claims, south of the Eagle-Shawmut mine, was the third Mother Lode property to be taken over. F. W. Page, manager of the Royal Consolidated mine at Hodson, Calaveras county, and James T. Currie, manager for an English company owning extensive oil-producing properties in California and Mexico, hold the bond to purchase this property. The Mammoth, one of the group, contains a large



MAP OF TUOLUMNE COUNTY.

body of low-grade ore, which is being mined from the face of a 700-ft. adit. In the Republican a drift is being driven north to cut a vein beneath the Orcutt claim, from the surface of which $75,000 was taken years ago. In extending this drift last week a new vein was cut, of good value. The 20-stamp mill is being overhauled, and will be started on ore from the Mammoth within two weeks.

On the east belt many properties are being examined, and a few deals are about to be made. Lessees at the Live Oak mine, a southerly extension of the Black Oak, and owned by the Black Oak Mines & Mills Co., in widening an old shaft have cut a vein assaying from $55 to $150 per ton. Several tons put through the Black Oak mill yielded $30 per ton. The lessees are A. R. Blackburn, A. C. Macomber, and Harold Stage. Under the terms of lease they are privileged to hold the property for six years, and work it to a depth of 400 ft., and drive in any and all directions within the limits of the mine's boundaries. The owning company will treat the ore extracted at a price a little over actual cost.

DEADWOOD, SOUTH DAKOTA

TUNGSTEN PRODUCTION AND OCCURRENCE.—ORE VERTICALS.

Tungsten ores have during the past few months been receiving more attention from prospectors. The increased prices have naturally stimulated search for the ores, and numerous old veins and many new ones have been developed. In the Hill City district, which appears to be one of the most extensive fields in the Black Hills, over 50 lode-claims have been located in the past few weeks, to cover some of the known outcrops. But the Wasp No. 2 mine, at Flatiron, two miles south of Lead, has made by far the largest production of ore. Since early in the summer, when the first shipment was made, the company has realized over $100,000 for the product which has been marketed. These shipments have consisted of cobbed ore, and have contained an average of close to 50% tungstic acid. A large quantity of lower-grade ore, the result of sorting, has been piled on the dump, and to handle it a concentrating-plant of 25 to 30 tons daily capacity will be installed as soon as the machinery, which has been ordered, is delivered. It now appears that the company's profits from the wolframite will be greater than its net realization from its cyanide-plant. Last month a dividend of 10c. per share was paid, making a distribution of $50,000; this was largely credited to the wolframite production. Previous disbursements this year have been ½c. and 1c. per month.

In the Black Hills are three known areas of tungsten ores, namely, the Lead-Flatiron, Tinton, and Harney Peak pegmatite districts. In the first, which includes the Wasp No. 2, Two Strike, and other properties at Flatiron, and the Harrison, Durango, and others in west Lead, the ore occurs as a replacement of dolomite, at and near the top of the Cambrian quartzite. The deposits lie in a nearly horizontal position, are one foot or so thick, four or five feet wide, and at times are several hundred feet long.

In the Harney Peak pegmatite area the wolframite and ferberite occur in quartz veins and pegmatite dikes, but so far no production has been recorded from the latter. The veins are from a few inches to a foot or more thick, occasionally with a pegmatite or granite wall, but usually enclosed between schist walls. They ordinarily trend in a direction parallel to the schistosity of the wall-rock; there has been but one cross-vein, cutting the strike of the schist, called to the attention of the writer.

In the neighborhood of Hill City, Oreville, Keystone, and Spokane, a large number of veins have been identified, which, while they are small, as has been noted, give promise of yielding a good quantity. These ores are easily crushed, and may be readily concentrated. The quartz veins as a rule produce clean ferberite, with occasional scheelite, and since they contain no pyrite, tantalite, columbite, or other heavy interfering mineral, a good product is made. At Flatiron the ore is fine grained, extremely hard, and tough, necessitating grinding to not coarser than 30-mesh in order to make a good recovery by concentration. The ores are mostly wolframite; scheelite is a rarity, and occurs only in small grains. In the Tinton district the lodes which yielded placer scheelite and wolframite were probably lower grade than those at the other points mentioned; probably the placer deposits are erosion products of large pegmatite dikes containing small quantities of the tungsten minerals.

It appears from present developments that the Heidelberg property, three miles east of Deadwood, is in a region of more than ordinary mineralization and enrichment. In the part exploration of less than 1500 ft. of the ground, five ore-making 'verticals' have been disclosed. (A vertical is a localism of the Black Hills, applied to mineral-filled fissures and fractures cutting the Cambrian rocks, and through which the ore-forming waters circulated. Where the verticals traverse lime-shales and dolomitic rocks, deposits of gold ore have been formed; the verticals themselves are enriched in the neighborhood of these rocks.) The latest vertical to have been discovered gives promise of developing into one of the most important. It had scarcely been followed beyond the surface at the time of the visit of the PRESS correspondent, when already a fair-sized dump of $12 to $15 gold ore had been sorted, and a dump of milling grade established. To cut this seam on its strike some 350 ft. from the surface, a cross-cut is being driven from the main adit. The face of ore was about 4 by 6 ft. In other verticals which have recently, or during the past fall, been identified, the gold-content has not been so great, but additional work on them may at any time reveal ore of better grade. The Heidelberg company is strictly a Deadwood concern. The company is slowly and steadily developing its property to the point where a small cyanide-plant will be necessary.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Fairbanks

Placer mining at Fairbanks was reported as finished for the season during the last week of October. The dredge on Fairbanks creek was expected to work until November 1.

Tungsten ore of high grade is reported to have been found in commercial quantities near the head of Gilmore creek. Claims were staked by Albert Johnson.

Opposite 8, 9, and 10 Above, Livengood creek, at Tolovana, J. Allman has opened gravel containing $1.50 per sq. ft. of bedrock, at a depth of 45 feet.

Over $150,000 of antimony ore has been shipped from this district this year.

Juneau

On November 29 the Alaska Mexican, Alaska Treadwell, and Alaska United companies will pay dividends No. 79 of 10c., No. 114 of 50c., and No. 33 of 30c., per share respectively.

It is expected that the Alaska Gastineau company's Annex creek power-plant will be supplying current by December 1. The tunnel to tap the water of Annex lake will be through by January 1. The transmission-line to the Perseverance mine has been ready for some weeks. At the mine there are 650 men and 81 machines working, in charge of B. B. Neiding. The company employs 1300 men in all, the last pay-day being $150,600.

A mine-rescue corps has been organized at Treadwell.

At the Chichagoff quartz mine near Sitka, an addition of five stamps and a tube-mill has increased the daily output to 110 tons. James L. Freeburn is superintendent for the owners at Tacoma, H. P. Wallace and W. R. Rust.

ARIZONA

Bulletin No. 3, mineral technology series No. 1, of the Arizona State Bureau of Mines, is a directory of Arizona minerals. About 110 minerals are given, with brief notes on their occurrence and locality.

Manganese ore is found in certain mines of the Tombstone district, Cochise county; the Clifton-Morenci district, Greenlee county; 30 miles south of Wickenburg, Maricopa county; at Salome in Yavapai county, and in the Mohawk mountains of Yuma county, according to P. E. Joseph in Bulletin 4, Mineral Technology Series 2, of the State Bureau of Mines.

Discussing what is known in this State as the Eighty Per Cent Law, *The Copper Era* of Clifton says the following, in part:

"As expected, the law initiated in Arizona at the last election has been declared unconstitutional by the United States Supreme Court on the broad ground that it was in violation of the Fourteenth Amendment. The case went to the Court from Cochise county, and was commenced by a foreigner who had been discharged under the provisions of the new law, which prohibited the employment by any employer of more than 20% of employees who were not qualified electors. The Court ruled that no State has the right to prohibit a person from earning a livelihood after that person has been legally admitted into this country under the immigration laws of our own making."

Cochise County

The Grace Dodge Memorial Home, at Bisbee, the gift of the Copper Queen Mining Co., was opened on November 19.

Gila County

A bond issue of $350,000 for better highways in this county was approved by election at Globe, Miami, Hayden, Winkelman, and other centres on November 15. This improvement will be of value to the mining community.

Greenlee County

In an editorial in its issue of November 12 *The Copper Era* of Clifton has the following, in part:

"Two months have passed since the employees of the three large mining companies in the district obeyed the strike order of Western Federation of Miners organizers.

"With the exception of the electric-light plants, not a wheel has turned since that time in the entire district; approximately 5000 men have remained in idleness, and at the end of the 60-day period the financial loss to each and every one is being keenly realized. Already the loss in wages alone is $1,000,000 and the loss to the mining companies is several times that amount, while the independent business man, together with his force of employees, has been proportionately affected.

"The outlook for an immediate settlement of the strike is not hopeful to say the least, unless perchance, Hywell Davies, of Lexington, Kentucky, the official conciliator of the Department of Labor, who is now in El Paso, may work out some plan which will be acceptable to employers and former employees. In the beginning, however, Mr. Davies makes it plain that he has not come to the Southwest as a mediator.

"At the end of the second month, as it was in the beginning, the stumbling-block between the former employees and the mine managers is the Western Federation and its organizers. Both sides are fully alive to the significance of the result of the labor troubles in this district, and unfortunately for all concerned, the indications are at the present writing that the contest will go to a finish, and the Clifton-Morenci district has been selected as the battle-ground.

"The duration of the strike apparently depends now on the determination of the mine managers to stand by their last statement, and the ability of the Western Federation to secure sufficient financial assistance from allied organizations to prolong the struggle indefinitely. Such is the situation. Gloomy, to say the least."

Mohave County

The first annual meeting of the United Eastern Mining Co. was held at Oatman on November 17.

The election of officers resulted as follows: president, Frank A. Keith; vice-president, G. W. Long; treasurer, R. I. Rodgers; secretary, Wallace Keith; directors, the above named with D. C. Jackling, Seeley W. Mudd, Ralph C. Nowland, W. K. Ridenour, Philip Wiseman, and J. L. McIver. A detailed report of the property will be published in the near future. Developments have been very good. The new shaft is to be sunk at once. Machinery has been ordered for the new 200-ton mill; it will consist of gyratory crusher, ball-mills, tube-mills, and Dorr continuous-decantation plant. The ore in the ball-mills will be crushed in cyanide solution. George W. Long is superintendent.

Yavapai County

Good rains have stimulated mining in this county. Four new mills have been waiting for water, and can now start. Placer work is increasing.——On Lynx creek the Lafayette Placer Co.'s claims have been sold to Wichita, Kansas, people,

headed by C. S. Israel. A dam for hydraulicking is to be built. ——On Slate creek the Dunkirk mine has sent its 14th car of copper-silver-gold concentrate to Hayden. Flotation is used here.

Tungsten ore has been found in the Eureka district, and prospectors are busy looking for more deposits.

At the Major company's Eureka mine in the Walker district, 20 men are employed, and ore is being shipped. A plant, including a Lane mill, tables, and flotation is proposed.

CALIFORNIA

Calcined magnesite is now quoted at around $30 per ton. In 1914 the quantity consumed in the United States was 122,000 tons of calcined and 13,000 tons of crude imported, and 11,293 tons of raw domestic, equivalent to a total of 132,000 tons of calcined magnesite. Austria supplied 93%, Greece 3%, and California the balance of 4%. Owing to the War the sources of import are practically closed, and the output of California, the only producing state, can not nearly meet the demands. The best magnesite comes from mines near Livermore, Alameda

MAP SHOWING DISTRIBUTION OF MAGNESITE DEPOSITS IN CALIFORNIA; THE BLACK DOTS REPRESENT THE DEPOSITS.

county, while one in Sonoma county yields a good refractory product, in demand by steel makers for their furnaces. The accompanying map, showing the situation of magnesite deposits in this State, is from the U. S. Geological Survey report by Charles G. Yale and Hoyt S. Gale.

According to the State Mining Bureau, the new work of the Bureau in protecting the oilfields against underground water is progressing satisfactorily. The appointment of practical oil men as deputies in the fields has been thoroughly appreciated. Owners are all in favor of the work and are beginning to send in the necessary information. A few months more will see the system fully understood by all operators. The nature of information necessary for this work calls attention to the fact that the producing of oil is now considered more as a business than a gamble. Formerly men would spend thousands of dollars in drilling wells, and would have no record of their condition or method of drilling, and would also continue operations without recording the productiveness or behavior of the various wells. The same men would not have thought of investing money in another line of business without a complete inventory and regular accounting. The logs of wells and monthly production reports required by the Bureau for its work are of even greater value to the operators furnishing them. General realization of these facts accounts for the hearty co-operation of the operators with the Bureau. A list is given in a press bulletin of drilling new wells, deepening or re-drilling present wells, and tests of water shut-off.

Amador County

The following is the preliminary report of the output and costs of the Plymouth Consolidated for October:

Ore milled, tons	11,000
Total value	$54,499
Workings expenditure	29,301
Development charges	3,328
Surplus	$21,870

According to W. J. Loring, the Plymouth Consolidated is controlled by an English company, and of its 240,000 £1 shares, 60,000 are held by Americans. The company spent $830,000 of English money up to the time that milling began. From August 1, 1914, to October 1, 1915, the gross yield was $686,073, with a profit of $218,030. The mine is equipped with 30 stamps. A total of 141,623 tons was treated during the above period. The average duty per stamp at the present time is between 11 and 12 tons, and the recovery is a fraction under 90%. The total cost, including development, which is a heavy charge, amounting to $6000 to $9000 per month, is less than $2.90 per ton. James F. Parks is manager.

Butte County

(Special Correspondence.)—Statements have been made recently to the effect that there is a boom in mining around Forbestown, whereas in reality nothing has been done on which to base a boom. Many men come here looking for work on the strength of these reports, and find no openings. There is a great deal of low-grade sulphide ore in some properties, but the owners will not sell at reasonable prices, hence the place is quiet.

Forbestown, November 16.

The Triumph mine at Lumpkin is to be re-opened by F. A. Thompson, after being idle for several months.

Eldorado County

According to Burr Evans in the *Placerville Republican*, the pay gravel of the buried river channels is cemented in some places, necessitating crushing by stamps; in other places, as at the Rising Hope mine, three miles from Placerville, the gravel is loose, making treatment easier. The latter has been washed as in ordinary hydraulicking, but with heavy losses of fine gold. A barrel gravel mill is now working at this mine, making a good recovery. Its first cost is low, and it does not crush the gravel, simply disintegrates and washes it. The fine material is then run over riffles and shaking-tables. This 5 by 3½-ft. machine treats six tons per hour. The amalgam from the table is retorted as usual.

The Eureka slate quarry, near Placerville, is being prepared for production. Towers are being erected for the tram that carries the product across the American river to within two miles of Placerville. The quarry was idle for five years.

Four miles below Placerville the Webber Creek Dredging Co. is to commence dredging this week. Twenty men are employed.

Mariposa County

The Fremont grant has been inspected by E. H. Benjamin, president of the Mariposa Commercial & Mining Co., owning the area, and W. C. Ralston, well known in this State, in company with F. T. Maguire, the resident manager. They examined the condition of the various mines, as negotiations for the purchase of the property are well under way, and a new company, composed of Eastern capitalists, is being organized to operate the mines, which is expected to be at an early date. It is at the Mariposa mine that these men have their hopes for successful operation of the property.

It is well known in connection with this mine that it has paid dividends from $2000 to $20,000 per month. Mr. Ralston

expressed surprise that the mine was allowed to close down. The shaft is 1600 ft. deep, and the workings confined to levels only a few hundred feet in length, both east and west. The buildings are in bad condition, the large boilers and other machinery are off their foundations, and exposed to the elements, shaft is also caved from the collar to a considerable depth.

Shasta County

Good ore has been cut at 1300 ft. in the Gladstone mine at French Gulch; this is 100 ft. lower than before. A drift 700 ft. long had to be driven to cut the vein. A bonus was given to the miners for fast work. The general manager, J. O. Jillson, estimated that ore would be cut by November 11 or 15, and this was done on the 14th. E. L. Young is superintendent.

Sierra County

The 10-stamp mill at the Red Ledge mine at Alleghany is ready for crushing; plenty of ore is broken for it. B. James is in charge.——At the Croesus company's Oriental mine the 10-stamp mill is almost ready. At its Plumbago mine 15 stamps are dropping.——At the Tightner the deepest work in the district is being done.

Siskiyou County

(Special Correspondence.)—Mining is fairly active in the Salmon River district. The late rains have provided sufficient water to start hydraulicking at several properties, and the season promises to be an active one. The Van Brunt, Siskiyou, and other large properties have been placed in shape for extensive production, new flumes built, and additional ground developed. Quartz mining also shows progress. The Big Cliff Mining Co. is increasing its working force, planning new developments, and preparing to install a good deal of machinery. The orebodies are large and of good-grade. The Siskiyou Syndicate has purchased a mill for its Cub Bear mine, and is endeavoring to place it in commission before much snow arrives. Arrangements have been made for vigorous developments during the winter. Work will also be continued at the Blue Jeans, and other mines. Large quantities of wood have been stored at the Black Bear mine, for the steam plant, and a campaign of aggressive developments has been decided on. It is stated recent prospecting in the property has opened promising territory.

Discoveries of manganese in the western part of Siskiyou county are attracting much interest. Representatives of the U. S. Steel Corporation have examined a promising deposit in Callahan gulch, near Sawyer Bar, and other properties in this section are receiving attention. As the road conditions in this district are not satisfactory, a movement has been started to improve the highway from Etna Mills to Orleans, from which point crude ore could be sent to Eureka for shipment by water. A good road would also encourage gold mining in this district, as several properties are idle largely because of heavy transportation costs.

Etna Mills, November 15.

COLORADO

Clear Creek County

(Special Correspondence.)—A two-foot shoot has been cut on the Boulder Nest vein, intersected 2000 ft. from the portal of the Commodore adit on Red Elephant mountain, and a recent carload shipment was settled for $140 per ton in gold, silver, and lead. The ore has been stripped for a length of 20 feet.

The Climax property on Columbia mountain is being developed, operations being carried through the Leasch adit. A well mineralized vein is now being opened. J. R. Calden of Denver is manager.

A deal is now pending whereby the Princess of India adit will be consolidated with the American Sisters property. Both are situated on Columbia mountain, and it is proposed to extend the adit under the flat to cut the American Sisters vein. J. J. White of Georgetown is owner.

An orebody, two feet wide and assaying 225 oz. silver per ton, has been opened in the Albro mine on Albro mountain. The vein was opened by a cross-cut, and was reached at an increased depth of 250 ft. under the shaft workings. Earl Dingle of Dumont is the lessee.

The Q. D. L. Leasing Co. has started work on the East Lake mine on Bellevue mountain. Work is done through the Big Five adit; a winze is to be sunk 100 ft. to undercut the Mosher ore-shoot that has been yielding about $10,000 per month for more than a year. G. K. Kimball is manager.

Idaho Springs, November 16.

Lake County (Leadville)

The rise in price of silver has given a better tone to producers of that metal at Leadville.

The Western Zinc Oxide Co.'s plant is working full time, receiving plenty of carbonate ore and making a good product.

Water in the Penrose shaft is down about 690 ft. The old levels are being cleaned out and repaired.

Ouray County

The Wanakah smelter is to be moved from its present site to one just south of the mill. About $2000 per month will be saved in freight, handling, etc.

San Juan County

The Yukon mill on Cement creek, near Silverton, is to be rented by the Colorado Metal Co. for the treatment of tungsten ore from the Dawn of Day mine near Gladstone.——The Mears-Wilfley mill is closed until next spring on account of the cold weather. Flotation has been very satisfactory at this plant.

Teller County (Cripple Creek)

Lessees at No. 5 level of the Empire State shaft of the Isabella property have opened a new shoot in the Mahoney vein, 24 to 30 in. assaying $25 to $30 per ton. This vein was thought to be worked out.

At the Elkton the shaft is down 73 ft. below No. 16 level. Water is receding at the rate of 16 ft. per month. Over 25 sets of lessees are working, and the output in October by them and the company was 1800 tons.

The old Rhinocerous and Nil Desperandum claims on Raven hill have been leased to H. M. Roeschlaub of Denver.

IDAHO

Shoshone County (Coeur d'Alene)

According to *The Wallace Miner*, the absence of transportation facilities in several areas of the Coeur d'Alene region in which there is great and ever increasing mining activity, and in which actual tonnage for a railroad is ready for extraction, is responsible for the idea that next year will witness the construction of at least one branch railroad and possibly more. There are rumors that the Chicago & Milwaukee is also preparing to enter this field, particularly the ore haul from the mines to the Northport smelter, in Stevens county, Washington. That the O.-W. R. & N. railroad would eventually build up Beaver creek from its north fork branch has long been regarded as certain, the company simply waiting until the mines of that rich area have reached a point of development that would ensure plenty of ore. The time has now arrived when such a line is a necessity, and it is thought that the O.-W. R. & N. will enter that field in the spring. The Interstate-Callahan will undoubtedly in time change its outlet to Beaver creek, and is supposed to have had that in view when it secured a mill-site on the north fork. The Tuscumbia is already a shipper, and also the Idora, while the possibilities presented by the Sunset, Portland, Beebe, and numerous other properties which promise large tonnage at no distant date certainly present a field for profitable business that no railroad company can afford to ignore. With such a showing it is a safe prediction that next summer will witness the construction of a railroad from the North Fork up Beaver creek to the base of Sunset peak.

According to reports from Pine creek, that area was visited last week by a representative of a railroad company, evidently for the purpose of gaining first-hand information regarding the quantity of ore blocked out. The rapid strides now being made in the development of these mines justify the attention they are receiving from the railroad companies. Already ore shipments from Pine creek have reached a point of considerable importance, and one mine, the Highland-Surprise, is now in position to make regular shipments of concentrate. The plans for the development of the Constitution include the erection of a mill in the spring, and the same is true of the Amy and Matchless. The Little Pittsburg is preparing to make shipments, and numerous other properties are rapidly approaching the productive stage. The fact that Pine creek is without transportation facilities has been a serious drawback to its development, but in spite of this handicap its enterprising operators have demonstrated that it is a profitable field for a railroad, and its construction would at once give an impetus to mining that would soon make the Pine creek branch a valuable addition to the railroad system of the district. Pine creek should have a railroad next year.

MICHIGAN

The Copper Country

The last bi-monthly pay-day in this region was on November 13, when approximately $700,000 was distributed, one company paying $230,000. The present annual wages are at the rate of $17,000,000.

At the White Pine Extension property, forest is being cleared, a 4½-mile wagon-road constructed to Nonesuch, machinery has been ordered, and foundations for 11 buildings completed. The buildings are to be of corrugated iron on the outside, lined inside with fire-proof plaster board and plaster; all will be steam heated and electrically lighted. A turbo-generator will supply current. Work on the new shaft will commence early next year. Over 100 men are employed.

MISSOURI

Jasper County

According to an address given by U. S. James of Newark, New Jersey, before the Southwest Missouri Mine Safety and Sanitation Association at Webb City, Joplin millmen are not getting the best results from slime treatment. He discussed rolls and table work.

On a lease of the Squires land at Galena, T. Tarr is erecting a tailing-mill of 750-ton capacity per shift. It will treat a large dump at the Squires custom-plant, which contains 3.5% blende. According to the *Joplin News Herald* an interesting feature of the mill is the installation of Dorr thickeners, the only ones in the district, to be constructed of concrete. They are circular in form, the sand thickener being 18 ft., and the slime thickener 30-ft. diameter; each is six feet deep. A Miller gas-engine of 135 hp. will be used to drive the mill, the equipment of which consists of two 36 by 48 rougher jigs and one 30 by 52 cleaner jig; seven elevators, five screens, two sets of 30-in. rolls; 11 tables, arranged as follows: one Butchart system Wilfley rougher, ordinary Wilfley rougher; four sand-tables; one finishing sand-table, three slime-tables, and finishing slime-table. Concentrates are drawn for the shipping bin only from the two finishing-tables, and from the cleaner-jig.

MONTANA

The State compensation act has been in force three months. Of 1289 accidents, 20 were fatal. Total benefits paid were $24,865. Of the 1289 accidents 596 are attributed to the negligence of the employees; 40 to the negligence of the employer; 77 to the fault of a fellow employee; 47 to a defect in a machine, and 528 are accounted unavoidable. Sixty-seven per cent of all the accidents occurred in the mining industry; there were 10 fatal accidents in mining, five at the smelters, two on electric railways, two in power-plants, and one in a coal mine.

Under plan No. 1, 21,625 employees are insured. The total annual pay-roll is $25,457,711. There was paid out during the first quarter, $23,489. Under plan No. 2, 10,841 employees are insured. The annual pay-roll totals $8,363,188. There was paid out $1,306. Under plan No. 3, 2170 employees are insured. The pay-roll totals $369,069. There was paid out $157.

The commissioners' report states that if the proportion of accidents continues the same throughout the year, 20 out of every 100 men in the mining industry will be injured, 12 out of each 100 in the smelting industry, and 10 out of every 100 in the lumbering and logging industry.

Lewis and Clark County

During the four weeks ended October 15, the Franklin mine in the Scratch Gravel district, owned by the Thomas Cruse estate, made a profit of $25,493; and from December 20, 1914, to that date the profit was $162,476. At the Cruse mine at Marysville, operations from December 20, 1914, to August 15, 1915, left a loss of $40,686. Work may be suspended.

NEVADA

Clark County

(Special Correspondence.)—The Goodsprings district is very busy, about 400 miners being employed, and 28 properties are shipping ore, mostly zinc, also some lead. The output in July was worth $250,000 gross, so the present value may be figured from that. Water is scarce here, it being hauled by rail and then delivered by auto-trucks to the mines, 18 miles in one instance. This necessitates dry treatment of the ore, the Stebbins dry concentrator being used, giving a good separation. The ore is a carbonate of zinc in dolomite, with some galena; sphalerite is rare. The Bullion, Frederickson, and Yellow Pine have mills. The Mobile mine produces 120 tons of crude ore per month. It is controlled by the Walkover Shoe Co., of Boston. W. S. Black is superintendent. Over a good road, eight miles long, the district's products are carried to Jean on the railroad, for shipment to Kansas smelters.

Goodsprings, November 17.

Humboldt County

At a distance of 1350 ft. from the entrance of the Friedman adit, a vein was cut on November 13, which, up to the 16th, was 34 ft. wide, with the face still in ore. The best ore is on the foot-wall, the last 15 ft. assaying from $6 to $20 per ton.

According to L. A. Friedman of the Rochester Mines Co., the orebody was cut at 1342 ft. from the portal of the adit. Up

PRESENT CONDITION OF ROCHESTER MINES PROPERTY.

to November 20 the lode was 45 ft. wide. It may be termed a contact vein, with an andesite foot-wall and a rhyolite hanging wall, lying almost flat. For 21 ft. it was worth from $1 to $6 per ton. At this point a quartz vein came in, at an angle of 45°. This is from 8 to 10 ft. wide, and assays from $6 to $20. The last sample taken from across the greater portion of the vein gave $7.20 in gold and $5.45 in silver. The adit will be driven to the 1500-ft. point. After that raises will connect with the orebodies between the 400 and 600-ft. levels, below the bottom of the winzes. Winze 301 is in 26 ft. of ore, worth from $10 to $30, with occasional $90 assays. Winze 302 is in 10 ft. of ore of similar value.

At a depth of 1500 ft., in the winze at the Seven Troughs Coalition mine, the vein has been cut, showing a good and wide body of ore.

Mills in the districts contiguous to Lovelock are the Seven Troughs Coalition, with a monthly output of about $60,000 (for November); Rochester Mines, $60,000; Lincoln Hill at Rochester, $5000; and Darby at Mazuma, 50 tons of $20 ore daily. The new Nevada Packard at Rochester will soon be yielding $1000 per day, while the St. Anthony Mines Co.'s tungsten plant at Toy is treating 50 tons of ore per day, its value being variable.

Esmeralda County

The preliminary report on the Jumbo Extension October output is as follows: ore shipped, 3476 tons; gross value, $112,000; sampling, freight, and treatment, $32,000; smelting losses, $14,000; mining and development charges, $16,000; and net realization, $50,000.

Experiments to treat the copper-gold ores of the deeper workings of the Goldfield district have been under way for some time, and it is announced, according to the *Tribune*, that a 30-ton flotation-plant will be erected at once at the Goldfield Consolidated mill. A statement to this effect appeared in the Press of October 9.

At a point in the north drift of the 1750-ft. level of the Atlanta, where 5½ ft. of $40 ore is showing, and farther along the drift 15 to 20 in. of $70 ore, a winze has been started. This work is of great interest.

Lincoln County

The Prince Consolidated company at Pioche is shipping 400 tons of ore daily, with good profit. Development is said to have disclosed a large quantity of ore.

Lyon County

It is reported that the Mason Valley company's smelter and leaching-plant at Thompson will resume work early in December.

Mineral County

A good deal of tungsten ore is being produced by C. E. Noble at Sodaville, who employs 35 men. The ore is shipped to San Francisco.

Nye County

Companies and lessees at Tonopah last week produced a total of 10,093 tons of ore worth $207,634.

In October the Belmont mill treated 12,342 tons of ore yielding 208,058 oz. bullion, with a profit of $65,069.——The Tonopah company's plant treated 12,435 tons averaging $12.80 per ton, with $60,700 profit.——The Extension profit was $66,000.——From 4604 tons the Jim Butler profit was $27,067.

White Pine County

(Special Correspondence.)—Tungsten mining is increasing in activity in the county, a lot is being found, and many new locations are being made, about 30 men locating near Osceola. Several engineers are investigating the areas. Three mills are working, and a fourth being erected. The mineral is found for over 100 miles. In Snake range, a discovery of scheelite has been made in Big wash, 10 miles south of Snake creek, which is eight miles west of Garrison, Utah. The owners are packing high-grade ore off the mountain, 9000 ft. altitude, with burros. Chapman and Taylor, for a San Francisco company, are operating at Snake creek and Sacramento pass; cold weather and snow interferes with their mill work. The U. S. Tungsten Co. is employing over 100 men south of Osceola. It is reported that one can sell a 65% product for $45 per unit. The old Victoria copper mine in Dolly Varden district, 15 miles north-east of Currie, on Nevada Northern railroad, is making regular shipments.

Ely, November 15.

NEW MEXICO

Grant County

The Carlisle property of G. H. Utter at Steeplerock has been sold to New York people for $300,000. The mine is opened to 637 ft. and has produced a good deal of ore.

OKLAHOMA

Ottawa County

After doing 40,000 ft. of drilling in its land at Picher during the past two years, the Picher Lead Co. decided to erect four large mills, the first of which, of 300-ton capacity, commenced work last week. It is motor driven throughout. The total quantity to be treated by the four plants will be 1400 tons per 10-hour shift.

UTAH

Piute County

Five miles north of Marysvale another deposit of alunite (potash mineral) has been discovered. It is under a cap of iron ore, which has been mined to some extent. The alunite assays 9% potassium sulphate. Development of other deposits south-west of Marysvale is encouraging. The Mineral Products Co.'s new mill is working well, producing a good grade of potash.

Summit County

Park City mines shipped 1295 tons of ore last week.

A centrifugal pump of 1000-gal. capacity per minute has been ordered for the Ontario silver mine, to be installed at 1700 ft. The property is now drained to the 1500-ft. level by the Ontario adit, which is used to drain most of the properties at Park City.

WASHINGTON

Grays Harbor County

(Special Correspondence.)—Twenty-five miles from Aberdeen five outcrops of manganese ore have been uncovered in the Olympic forest. Some of the ore assays up to 58% manganese and 4% silica. A market is being sought for the product.

Aberdeen, November 20.

Stevens County

Spokane people are to revive the old Deer Trail district, 25 miles west of Springdale, as modern methods should result in profitable work. The Deer Trail mine is said to have yielded $3,000,000 from 1893 to 1902, and the present owner, the Deer Trail Mining & Development Co., in charge of A. Robinson, is to erect a 75 to 100-ton mill driven by oil-engines. The mine is developed by adits to a depth of 900 ft. Stopes and dumps are estimated to contain 250,000 tons of $7 ore.——The Silver Basin mine has also been extensively opened, and work will be resumed early in December. The output is about $300,000. Freight and treatment at smelters cost $11 to $20 per ton.——The Silver Hoard claims have been under development since September 1, with good results. A mill is proposed.

At the Laurier mine near Colville, a 1½-mile tram has been laid from the mine to the station at Laurier. Shipping to Greenwood is to commence. Dumps contain 20,000 tons of ore assaying $10 to $40 per ton in zinc, copper, and gold. G. Stewart is manager.

The Kettle River field, just south of the international boundary, is being actively developed.

In September the United Copper company at Chewelah made a profit of $4423; November earnings are expected to be over $25,000. The 74 stamps are crushing 225 tons per day. Flotation is used, and the recovery is from 77 to 80 per cent.

WISCONSIN

Grant County

(Special Correspondence.)—New producers at Platteville during the past 30 days are the Star, Climax, Kistler, Big Bills, M & H, and Lucky Three. A new electro-static plant is called the Enterprise. The Hodge, Acme, Homestead, Grant County, Crnson, East End, Klar-Piquette are all operating steadily.

At Cuba the National Zinc Ore Separating Co. is treating

800 tons crude concentrates per week and shipping an average of eight cars of high-grade refined concentrate. Campbell Separators are shipping two cars high grade weekly. Utt-Thorne Co., Anthony, Rainsbeck, Gritty-Six Dominion Zinc Co. are all new producers.

At Hazel Green the McMillan Mining Co. is working three shifts on a capacity shaft, 9 ft. of solid milling area was cut from 61 to 70 ft. A new plant is partly complete. Service is set for December 1.

Platteville, November 10.

IOWA COUNTY

(Special Correspondence.)—At Highland the New Jersey Zinc Co., after a drilling out program has ordered a two-cage shaft sunk and will remove the plant in use at the Kennedy mine to the new Eberle ranges.

Three new power and milling plants are being constructed at Linden, one each on the Gilman, Optimo No. 3, and Stoner mines. Milwaukee capital is flowing into this district.

The O. P. David mine, at Montfort, after a two years' shutdown is now on a producing basis.

Freer buying of late has awakened the Mifflin district, which is now shipping 15 to 25 cars of zinc ore weekly. The Coker mine alone delivered 41 cars to the Mineral Point Zinc Co. in October. This mine has been going steadily for 30 years; 12 consistent producers are found here.

The Lucky Five Mining Co., at Dodgeville, disposed of 300 tons of zinc ore last week to the Picher Lead Co.

Highland, November 10.

CANADA

BRITISH COLUMBIA

A tube-mill and cyanide-plant are being erected at the Relief mine near Erie, at a cost of over $20,000. A. D. Westby, the manager, states that the 10-stamp mill recovered 65%, and 90% is expected from the new equipment. About $100,000 of old tailing is to be treated.

During the 10 months ended October 30 the Trail smelter has received 399,070 tons of ore, against 325,631 tons in 1914. The Rossland district is responsible for most of the gain, while Nelson, Slocan, Ainsworth, and East Kootenai show decreases. Work on the new electrolytic zinc plant at the Trail smelter is being hurried. Current for the plant will be supplied from the Bonnington Falls station of the West Kootenai Power & Light Co. It is estimated that the energy required will be from 8000 to 9000 horse-power.

ONTARIO

(Special Correspondence.)—By next spring the gold production of Ontario is expected to exceed the output of silver. This will be due to the increased quantity of ore being milled, notably at the Hollinger, Dome, McIntyre, and Vipond mines. The smaller producers at Porcupine and Kirkland Lake will help. The Tough-Oakes at Kirkland Lake has paid its first dividend, three years from the day actual mining started. This much-advertised mine is doing better than some of its critics anticipated. The workings are now down to 500 ft., and the No. 2 vein maintains its high grade, as well as its width. The Teck-Hughes, control of which was recently acquired by the Buffalo Mines of Cobalt, is being equipped with a 60-ton mill, employing the counter-current decantation system. The work is in charge of Tom R. Jones. An option on the claims of the Kirkland Lake Goldfields, one of the boom flotations foisted in London, has been taken by Frank L. Culver of the Beaver Mines of Cobalt. Prospects at Kirkland Lake are considered excellent.

Cobalt, November 20.

During October the Alexo nickel mine at Porquis Junction, shipped 800 tons of ore to the Mond Nickel Co.'s plant at Conniston.

KOREA

The October clean-up of the Oriental Consolidated resulted in a return of $135,500.

PERSONAL

W. L. AUSTIN is here.

J. R. FINLAY has returned to New York from Butte.

H. W. ALDRIDGE is at the Inspiration mine, in Arizona.

E. V. BRAY sailed for the Celebes by *Shinyo Maru* on November 20.

J. H. HEDGES has moved to Long Beach, Cal., from Nacozari, Mexico.

W. J. LORINO has decided to make his headquarters in San Francisco.

D. W. BRUNTON came to San Francisco from Vancouver, on his return to Denver.

THOMAS CHALMERS, of Chalmers & Williams, was in San Francisco for a few days.

NELSON DICKERMAN, manager for the Pato in Colombia, has been taking a holiday in California.

WILBUR H. GRANT has returned from Octave, Arizona, and will leave next week for Forest City, California.

TAKESHI HIRABAYASHI, chief mining engineer for the Japanese government, visited the Joplin district recently.

H. R. VAN WAGENEN, now in charge of the Consolidated Nevada-Utah mines, at Pioche, is visiting the Exposition.

H. H. COLLEY, assistant-superintendent of the Douglas smelter of the Copper Queen company, is visiting Grass Valley.

CHARLES A. O'CONNELL, manager of the Tough-Oakes mine, at Kirkland Lake, is visiting San Francisco, his former home.

GEORGE M. COLVOCORESSES, general manager for the Consolidated Arizona Smelting Co., was in San Francisco this week.

F. W. MCNAIR, president of the Michigan College of Mines, will be in Los Angeles on the 29th, going from there to Salt Lake City.

SAMUEL W. COHEN, manager of the Crown Reserve mine, Cobalt, has been examining the Globe mine at Dedrick, in Trinity county.

OSCAR H. HERSHEY, FRED T. GREENE, and FRED SEARLS, JR., are giving expert testimony in the Alameda-Success case at Wallace, Idaho.

MAURICE W. BACON has resigned as manager for the Stewart Mining Co., at Kellogg, Idaho, being succeeded by WILLIAM BEAUDRY, the former superintendent.

Schools and Societies

The Southwest Missouri Mine Safety and Sanitary Association has a membership of about 100.

On November 23 the Carnegie Institute of Technology, Pittsburg, will celebrate the 80th birthday of Andrew Carnegie, and the 15th anniversary of the Institute.

The annual meeting of the Faraday Society was held in London on October 19. The following were elected to serve for the year 1915-16: president, Sir Robert Hadfield; vice-presidents, K. Birkeland, Bertram Blount, W. R. Bousfield, F. G. Donnan, Eugene Haanel, A. K. Huntington, and T. Martin Lowry; treasurer, F. Mollwo Perkin; and council, W. R. Cooper, C. H. Desch, J. A. Harker, Emil Hatschek, Cosmo Johns, Alfred W. Porter, E. H. Rayner, A. Gordon Salamon, George Senter, Cav. Magg. E. Stassano. At the 66th ordinary meeting on the same date, the time was devoted to a general discussion on 'The Transformations of Pure Iron,' introduced by the president. 'The Transference of Electricity by Colloidal Particles,' by F. Powis; 'Electrolysis of Nitric Acid, Sulphuric Acid, and Orthophosphoric Acid, Using a Gold Anode,' by F. H. Jeffery; 'The Electrolysis of Concentrated Hydrochloric Acid using a Copper Anode,' by F. H. Jeffery; and 'The Thermal Decomposition of Hydrogen Peroxide in Aqueous Solution,' by William Clayton, were taken as read.

THE METAL MARKET

METAL PRICES.

San Francisco, November 24.

Antimony	40
Electrolytic copper	20.75
Pig lead	5.50—5.70
Quicksilver (per flask)	$105
Spelter	21
Zinc-dust, 100-kg. zinc-lined cases	30

ORE PRICES

San Francisco, November 24.

Antimony: 50 and 60% products, per unit	$ 2
Magnesite: calcined, per ton	30
Manganese, 50% metal, 8% silica, per ton	12
Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot	$35—10

New York, November 19.

Antimony: prompt shipment from South America (paid) $2.35.

Tungsten: 60%, $45 paid for prompt; forward delivery done at $41; second half of 1916 quoted at around $35.

Vanadium oxide: no activity reported.

Manganese ore: no activity reported. About 16,000 tons of Indian ore is en route to an eastern Pennsylvania steel company.

Molybdenite: 90% MoS_2, per pound, $1.50.

There is a large difference in the price of tungsten between New York and London, the latter being much lower.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, November 24.—Copper is firm owing to very heavy buying; on account of foreign demand lead is firm; zinc is strong and active.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov. 18	51.37	Oct. 13	49.55
" 19	51.87	" 20	49.53
" 20	51.50	" 27	48.91
" 21 Sunday		Nov. 3	49.37
" 22	52.12	" 10	50.02
" 23	52.75	" 17	50.46
" 24	51.50	" 24	52.35

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	....
June	56.43	49.03	Dec.	49.27	....

Sharp advances characterize the silver market in New York and London, although sterling exchange remains rather weak. Pixley and Abell state that the volume of business is much the same, the firm tone being largely due to reduced American supplies, although China and Europe have been daily buyers. India bought lightly, but stocks at Bombay are heavy. Samuel Montagu & Co. write in a similar strain. The silverware trade in the East and England is much better than for some time.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Nov. 18	19.12	Oct. 13	18.00
" 19	19.37	" 20	17.87
" 20	19.62	" 27	17.79
" 21 Sunday		Nov. 3	17.89
" 22	19.62	" 10	18.08
" 23	19.87	" 17	18.58
" 24	19.87	" 24	19.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.16	14.38	Aug.	12.31	17.27
Mch.	14.11	11.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	....
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended November 16 totaled 5,820,479 lb., worth $1,059,324. France took 1,652,869 lb., and Sweden 2,241,175 lb. Imports amounted to 1,922,769 lb., valued at $265,095. Peru sent 712,080 pounds.

The Guggenheim Exploration Co., a holding company for some large copper interests, is to dissolve. There will be a distribution and re-arrangement of stocks held.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Nov. 18	18.25	Oct. 13	13.55
" 19	18.25	" 20	13.37
" 20	18.25	" 27	14.12
" 21 Sunday		Nov. 3	14.92
" 22	18.75	" 10	15.63
" 23	19.00	" 17	17.02
" 24	19.00	" 24	18.58

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	....
June	4.84	22.20	Dec.	5.40	....

The demand for ore at Joplin is large, buyers are active, and a rise of $10 per ton for 60% metal-content makes $120 to $125 per ton.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov. 18	5.25	Oct. 13	4.50
" 19	5.25	" 20	4.50
" 20	5.25	" 27	4.75
" 21 Sunday		Nov. 3	4.87
" 22	5.25	" 10	5.02
" 23	5.25	" 17	5.20
" 24	5.25	" 24	5.25

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	....
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Date.		Nov. 11	100.00
Oct. 27	93.00	" 17	100.00
Nov. 4	97.50	" 24	105.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.25	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	....
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	....
June	30.72	40.26	Dec.	33.60	....

Tin is quiet at 39 to 40 cents.

ALUMINUM

No. 1 aluminum, 98 to 99% pure, is quoted at 58 to 60c. Some desultory sales are reported, but the scarcity continues.

The Department of Commerce at Washington, D. C., reports the following metal exports during the 9 months ended September 30: Copper and manufactures, $83,900,000; iron and steel manufactures; $251,100,000; and zinc manufactures, $21,500,000; against $95,600,000, $152,800,000, and $3,200,000. Imports were: copper in ore, $10,000,000; copper manufactures, $22,000,000; and iron and steel manufactures, $14,800,000; compared with $9,500,000, $23,700,000, and $22,900,000.

Eastern Metal Market

New York, November 19.

A large business has been done in copper, a continuance of the movement previously reported. Large inquiries indicate sustained activity, and 20-c. copper is looked for. Foreign stocks are diminishing, and the London market is higher. Zinc has been active, and prices have mounted rapidly. War contractors and the galvanizing trade both have been large purchasers. Galvanized sheets are higher; sheet-zinc went to 20c. The leading producer of lead is credited with large sales on foreign account, and its price again has been advanced. Fear that Great Britain would close the Suez Canal gave tin consumers and dealers a scare, and they bought heavily at advancing prices. The fright seems to have been without cause, but the small stocks here will serve to keep quotations fairly strong. Antimony is up to near 30c. Not only is the supply small, but it is reported that Great Britain will attempt to control its marketing by imposing regulations similar to those laid down for tin. Aluminum is higher.

The United States Steel Corporation, which sells abroad as the United States Steel Products Co., withdrew quotations in foreign markets last week. Practically all of the steel companies are sold out for several months ahead. Meanwhile the demand shows no sign of lessening, and a steel famine is not at all an improbability. Purchasing has not been halted by sharp advances in prices. In the end the market will fall of its own weight. The nominal quotation for plates, shapes and bars is 1.70c. Pittsburg.

COPPER

The buying of copper, both on domestic and foreign account, has been heavy during the past few days. Prices have advanced to 19c., cash, New York, or 17.87½c., 30 days, delivered, the latter being the usual terms on which electrolytic is sold. Most of the trading was in electrolytic, inasmuch as the Lake companies are well sold up for the next few months, and many of them have withdrawn from the market. The nominal quotation for Lake is 19c. The higher prices caused domestic buyers to become active, but the bulk of the business done was on the part of war contractors. It is an interesting fact that, as intimated last week, many of the recent purchasers of copper are greenhorns at the business; but this is to be expected in view of the number of persons who are new to the business of making cartridges, shrapnel-cases, or copper-rings for shells. All kinds of individuals are visiting the offices of the copper companies, flippantly throwing down a blue-print or two and lightly asking for quotations on anywhere from one million to five million pieces. Many of the copper trade are getting bored because of these experiences. If the seeker after quotations is told that a mill is not properly equipped, he refuses to believe it, or asserts that it really makes no difference; what is needed can be obtained in a hurry. A good part of the purchasing, which runs into millions of pounds, has been negotiated very quietly. A larger foreign business could be done were it not for the difficulty of obtaining ocean freight room, just now a problem with all exports. A number of large inquiries are yet to be satisfied, and the trade thinks that copper will go to 20c. The London market is extremely strong. It was quoted on November 18 at £94 10s. (electrolytic.) Stocks in Great Britain and France are diminishing, as shown by the statistics of November 15. The English supplies on that date were 15,473 tons, against 18,410 tons at the end of October; French stocks were 1645 tons, compared with 1925 tons at the end of October. For some days a strike was on at the refinery of the Nichols Copper Co., Laurel Hill, Long Island, but it has been settled. The company made deliveries out of stocks, and was but little hampered. The base price of sheet-copper was advanced on November 18 to 24.25c. per lb. Exports from November 1 to 19 totaled 12,407 tons.

ZINC

Early this week there was a flood of inquiry in the market, and some large purchases were made for early delivery. Quotations advanced sharply, which served to bring the galvanizers in the market, their appearance sending prices higher. On November 17, spot metal was quoted at 18c., New York, and at 17.75c., St. Louis. The London market was strong at £86 on the 17th. Belief is general that the London market was cornered. It advanced £7 to £85 10s. on the 11th, and the following day went to £87, declined £1 the 15th and on the 18th went to £87 again. The domestic demand for galvanized sheets is very strong, the quotation having gone to 4c. on the 12th. As a result of the United States Steel Products Co. having withdrawn European prices, inquiries are now coming here from neutral countries, even the jobbers having received them. Incidentally, large consumers who usually buy direct from the mills are now trying to buy from jobbers. In the past few days December deliveries of spelter have been quoted at 17c., and January at 16.75c., though quotations vary considerably. Exports have been heavy, amounting to 3989 tons up to November 20.

The quotation for sheet-zinc, carload lots, f.o.b. mill, 8% discount, is 20 cents.

LEAD

As was expected, the A. S. & R. Co., advanced its quotation on November 15, and the new price became 5.25c. per lb., New York. It previously had been 5.15c., or $2 per ton less. The St. Louis quotation is ten points lower. The trade insists that the ordinary domestic demand is not good, and construes the advance to mean that some heavy foreign sales have been made by the leading producer. One report has it that through J. P. Morgan & Co., 15,000 tons was purchased for export delivery in 1916. The London market is not showing strength proportionate to that of the other metals, and the price there is below New York parity. The trade is convinced, however, that a large business is being done with foreign buyers. An even larger movement would take place were it not for the scarcity of freight room already referred to. Independents are well sold up, and are not cutting. Exports from November 1 to 20 totaled 2158 tons.

TIN

The tin market has had a feverish week, but is now quieter and quotations are easier. Early this week the price for spot went close to 45c. It was 37c. on November 10. Late last week the trade could get neither confirmation or denial of the reported closing of the Suez Canal, and buyers rushed into the market to protect themselves. As they did so, quotations went up. At 38 to 41c. between 600 and 700 tons was taken in one day (November 11), while on the following day, when the spot quotation was 44c., about 400 tons was taken. This week the market became quiet, and extremely so when private advices declared that nothing was known on the other side about the intentions of Great Britain with regard to the Canal. Stocks are low in this country and there is every indication that the price of the metal will be fairly well sustained. The quotation on November 19 was 41.62½c. Arrivals up to November 19 amounted to 1100 tons, and there was afloat on that day 4568 tons.

ANTIMONY

Large quantities of antimony have been taken by consumers, and the quotations for Chinese and Japanese grades have advanced to 38.50 and 39.50c. The supply is not large, and now comes a report that Great Britain is making its hand felt in this trade also. It is said that all antimony shipped from the Far East in English bottoms must be consigned to the British Consul at New York, who will release it only under certain conditions

COMPANY REPORTS

BUTTE & SUPERIOR COPPER CO., LTD.

The third quarterly report of this great zinc producer in Montana has been awaited with interest; it contains the following:

	3rd quarter.	2nd quarter.
Ore milled, dry tons	130,210	124,080
Zinc-content, per cent	17.147	17.003
Silver-content, ounces per ton	7.6027	8.067
Zinc concentrate produced, tons	37,396	35,840
Zinc in concentrate, per cent	55.1279	52.706
Total zinc, pounds	41,230,885	37,780,020
Silver in concentrate, ounces per ton	21.9646	22.714
Recovery in concentrate, per cent zinc	92.3322	89.536
Cost of mining	$3.4584	$3.3816
Cost of milling	1.7652	1.8108

The quantity of ore treated was larger than in any previous quarter.

The financial results, compared with those of the previous quarter, were as follows:

	3rd quarter.	2nd quarter.
Net value of zinc concentrate (at mill)	$2,997,128	$2,509,230
Net value of lead concentrate (at mill) and of residue	228,111	230,294
Miscellaneous income	14,715	11,899
Total net value	$3,239,954	$2,751,423
Operating costs	679,625	644,270
Profits	$2,560,329	$2,107,153
Metal inventories and quotations	201,510	.....
	$2,761,839	$2,107,153

The price of zinc on which the earnings are based is 13.6309c., a figure conservatively below the actual prices received on zinc sales made during the quarter, and the value of other products is also conservatively estimated. Spelter sales have been very satisfactory. The company has no unsold metal available for delivery, and a large amount of the estimated production for the remainder of the year has been contracted for sale at prices higher than those prevailing during the third quarter, and all concentrate production for the current year has been contracted for smelting.

The item of $201,510 'metal inventories and quotations' represents excess of actual amounts received from the sale of concentrates and smelter residues above the value at which these products are estimated in monthly statements.

At the end of the quarter, and after payment of dividend at that time, the company had on hand approximately $5,000,000 in quick assets, consisting of cash and products conservatively valued in process of treatment and in transit.

During the quarter the Black Rock shaft was continued to a depth of 1759 ft., the progress in sinking having been 56 ft. A station was cut on the 1700-ft. level, and a skip-pocket made at 1600 ft. Preparations are now being made to sink a new working shaft of greater capacity than the present one, designed for mining at much greater depths than could be economically served with the present small shaft. This new shaft will be situated entirely out of the orebody, and when completed will release large bodies of ore adjacent to the present shaft, which cannot safely be mined while that shaft is in continuous use as a main ore exit.

It will require more than a year's time to complete the new shaft and its equipment; in the meantime the present shaft will only be extended sufficiently to permit of regular production and at the same time facilitate development necessary to maintain liberal opening of ore reserves ahead of extraction. Underground development for the quarter was satisfactory in every way. Extensions of the orebody were disclosed in an easterly direction on all of the principal lower levels where work is now being conducted. No re-calculation of ore reserves was made for the third quarter; but it may be said that the new reserves developed were practically equivalent in quantity to the ore mined.

NATOMAS COMPANY OF CALIFORNIA

The president of this company, Frank B. Anderson, on November 15, issued a report containing the following information:

The Natomas Company of California was organized under the laws of the State of California, on December 24, 1914, to take over all of the properties of Natomas Consolidated of California. This was accomplished through a reorganization plan, with which the security-holders are familiar.

The tested dredging ground at January 1, 1915, contained about 190,000,000 cu. yd. of gold-bearing gravel. Since this estimate was made, additional prospecting on other areas included in the dredging department indicates that considerable additional ground exists, which will increase the net recovery from dredging operations. Twelve boats are operating, and another, Natoma No. 4, is now under re-construction and should be in operation by the first of the coming year. About 2,000,000 cu. yd. per month is being dredged. In 1914 the gross recoveries from these operations amounted to $2,650,579, of which $1,520,946 was net over cost of operation. During the first seven months of 1915 the gross gold recovery was $1,377,159, of which $655,115 was net. During this latter period the boat now under re-construction was not in operation, large expenditures were also necessary for dredge repairs and replacements during this period, all of which were charged to operating expense. The dredges have all been maintained in first-class condition. The figure at which the dredging property is carried as assets on the balance-sheet represents the estimated return during its life, less the cost of recovery and an amount sufficient to cover the amortization of the plant, including dredges.

The company owns and operates two rock-crushing plants, one at Fair Oaks bridge, Sacramento county, and the other at Oroville, Butte county, with a combined capacity of 3000 tons per day. There has been a good demand for this material, and the profits in this department have been satisfactory during the last 18 months, but the business is of such a variable nature that it would not be wise to attempt an estimate of the results to be expected for any period.

The reclaimed lands of the company, approximately 58,380 acres, lie immediately north of Sacramento, and extend for 36 miles along the Sacramento, Feather, and Bear rivers, in what are known as reclamation districts No. 1000 and 1001. When, in the early part of 1914, the re-organization committee took charge of the affairs of Natomas Consolidated, the reclamation work was in an unfinished state, and the lands in consequence were subject to annual flooding, and could be rented only during the dry season, for pasturage. About $1,800,000 had at that time been expended for reclamation work in the two districts, and it was estimated that $1,680,000 would be required to complete it.

As the Natomas company owns 85% of the lands in district 1000, it was necessary for it to undertake the construction work, and take district warrants and bonds in payment therefor in order to insure the completion of the reclamation work. Owing to certain features of the general plan for the reclamation of the two districts, it was necessary to complete the levee systems of both simultaneously, and as a consequence the Natomas company was also called upon to assist in financing the work in district 1001, in which the company owns about 40% of the acreage.

The satisfactory net proceeds from dredging during 1914 permitted the appropriation of sufficient funds to complete this

reclamation work before the close of that year, so that the levees successfully withstood the flood waters of last winter season.

About 35,000 acres of the company's lands in these districts were farmed during 1915 on a crop share rental, and the net returns to the company amounted to approximately $112,000. The drainage system comprises 31 miles of main drainage-canals, 74 miles of lateral ditches, two pumping plants, one containing four 50-in. pumps (now installed) and the other to contain two 38-in. pumps. It is expected that the drainage system will be entirely completed before the heavy rains of this season.

Results from the American River lands and the Natomas Water Co. are quite satisfactory.

Capital assets are worth $19,375,500, including the dredging, rock, water, and land plants; property suspense account, $6,329,500; securities and investments (in reclamation districts), $2,192,490; current assets (including $329,152 cash), $1,482,450; and deferred charges to operating surplus, $17,546, making total assets of $29,397,486. Liabilities include capital stock, $16,035,500; mortgage and bonded debt, $12,715,204; current liabilities, $268,255; reserves, $88,196, and operating surplus at July 31, 1915, $290,331.

MINING DECISIONS

Location and Assessment

The following query has been sent us:

"Mr. Smith located a mining claim on July 10, 1913, and was put on record at the same time. In the same summer that year he does enough work for the assessment, but in 1914 he does no work on the claim, and the work he did in 1913 is not put on record. On January 1, 1915, the claim runs out. On June 6, 1915, Mr. Adams comes along, and Smith offers him a half interest in the claim, and the claim is put on record according to law, they, Smith and Adams, having re-located the claim as partners.

"The point in law requiring explanation is this: Smith located the claim on July 10, 1913, and worked or prospected that summer, but did not record his work. In 1914, he does no work, and lets it run out. In 1915, on June 6, he takes in a partner and re-locates the claim as partners. Smith located claim in July 1913, and let it run out in 1914. He, Smith, re-located the above claim 22 or 23 months after July 10, 1913. Does the failure or neglect of any locator of a mining claim to perform development work of the character, in the manner, and within the time required by the laws of the United States, disqualify such locators from re-locating the ground embraced in the original location or mining claim, or any part thereof, under the mining laws, within three years after the date of his original location, and any attempted re-location thereof by the original locators shall render such location void? What should Adams do to hold his share in claim and have a clean title? Should he, Adams, re-locate the claim in his own name and give half to his partner, or would such be liable to a law-suit? that is, by Adams re-locating claim."

The above query is not as simple as it seems, and it raises a very novel question. Under Section 1426s of the California Civil Code, the failure of the locator of a mining claim to perform his annual assessment work disqualifies him from re-locating the ground at any time within three years from the date of his original location. The re-location of the claim within the three-year period by the original locator and a partner ought not to result in rendering the location void, provided the partner is himself a qualified locator and there is no collusion or fraud in the re-location such as a manifest attempt to evade the statute. Under these circumstances, assuming that the State statute in question is valid, the partner would own the entire claim, since the original locator is prohibited from himself re-locating, and naturally from joining in a re-location. Whether the original locator would have any recourse as a partner, and could compel Adams to later on convey to him any portion of the claim, would depend largely on circumstances. For example, a court of equity might take into consideration the fact that Smith had expended money or labor on the claim, and in this manner between him and Adams, it might be inequitable to allow Adams to retain the entire title. If Adams is a *bona fide* locator, clearly no third person could come in and question the validity of the re-location, for Adams is qualified to locate the entire claim; and if Smith, through the operation of the statute, is disqualified from becoming a co-locator, then the entire claim would belong to Adams, except that he might, as indicated, occupy such a relationship as co-locator to Smith that the latter could eventually compel an equitable settlement. A conveyance by Adams to Smith (after the three-year period had expired) of such an interest in the claim as would make Smith a one-half owner in the claim as a result of the conveyance, ought to straighten the matter out as far as Smith is concerned. The foregoing analysis will give some idea of the nature of the problems involved and is by no means submitted as being conclusive.

Upon giving the matter more careful consideration, however, it seems that the safest way to proceed will be to rely on the original location of July 10, 1913. Smith and Adams can make a mutual conveyance which will recognize the existence of this location and vest them each with a half interest in the mine. This, of course, is on the assumption that no one else has made an adverse location of the property since July 10, 1913. In the absence of any adverse locations, there was no necessity for making the re-location of June 6, 1915, for a mining claim does not, except in Alaska, become invalid and run out merely because the assessment work is not done. If there are no adverse locations, the original locator can perform $100 worth of work at any time and keep the old claim alive. If one proceeds on this theory, he will have to perform $100 worth of work without delay, if this has not already been done this year, and credited to the old location.

Miners' Liens—Receivership on Foreclosure

Held, that Section 8, Chapter 51, Laws of 1909 of South Dakota providing that a receiver of mining property might be appointed upon the mere filing of a suit to foreclose a miners' lien against said property was void, and amounted to a deprivation without due process of law, and an *ex parte* order made in pursuance therewith without notice to the mine-owner should be vacated.

Cessna *v.* Otho Development & Power Co. (South Dakota), 153 Northwestern, 380. June 19, 1915.

RECENT PUBLICATIONS

Report of the Department of Mines of Western Australia for 1914. P. 113. Illustrated. Perth, 1915.

The Epigene of the Desert. By Andrew C. Lawson. P. 26. Illustrated. University of California, Berkeley, 1915.

Manganese. By P. E. Joseph. Bulletin 4. Mineral Technology Series 2. P. 11. Arizona State Bureau of Mines, Tucson, 1915.

Comparative Railway Statistics. United States and foreign countries. P. 78. Bureau of Railway Economics, Washington, D. C.

Electro-Thermic Smelting of Iron Ores in Sweden. By Alfred Stansfield. No. 344. P. 65. Ill., index. Department of

Mines, Ottawa, Canada, 1915. Sweden is a country of large electric power development, resulting in great strides in smelting by electricity. This is a valuable contribution to the subject, written by a man who personally investigated the industry.

U. S. Bureau of Mines, Washington, D. C.:

Pulmonary Disease Among Miners in the Joplin District, Missouri. And its relation to rock-dust in the mines. A preliminary report. By A. J. Lanza and Edwin Higgins. Technical paper 105. P. 47. Illustrated. Abstracts have appeared in the Press from this publication.

Report of the Selby Smelter Commission. By J. A. Holmes, Edward C. Franklin, and Ralph A. Gould, with accompanying papers by other members of the Bureau staff. Bulletin 98. P. 528. Ill., map, charts, index. This bulletin describes in detail the methods used, some of them new, in determining the contamination of the air and the damage to trees, crops, and live-stock by the smoke and fume from the Selby smelter, in California, and gives the conclusions of the Commission on the methods used by the smelter company to prevent injury. The bulletin is of especial interest to metallurgical companies, municipal or state boards of health, and persons investigating damage by smelter smoke. Owing to the expense involved in the preparation and publication of this bulletin, and the limited printing funds available for the use of the Bureau, it has been necessary to place a price of $1.25 on the work. Orders should not be sent to the Bureau of Mines, but should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Department of Mines, Wellington, New Zealand, 1915:

Mines Statement by the Minister of Mines for the year 1914. P. 118. Ill., maps. The mineral output of the Dominion amounted to £3,297,927, an increase of about £100,000.

The Geology and Mineral Resources of the Buller-Mokihinui Sub-Division, Westport Division. By Percy Gates Morgan and John Arthur Bartrum. Bulletin 17 (new series). P. 210. Ill., maps, sections, index.

Imperial Valley and Salton Sink. By H. T. Cory. P. 438. Ill. John J. Newbegin, San Francisco. For sale by the Mining and Scientific Press. Price, $3.50.

The transformation of the Imperial Valley from a worthless desert into a cultivated region with an assessed valuation of many millions is one of the most interesting as well as one of the most romantic episodes in California history. Now that the Imperial Valley irrigation district is established on a reasonably firm financial basis and the other troubles of the valley are well on their way toward solution, it is fitting that a history of the project should be published. The main part of the book is Mr. Cory's paper presented before the American Society of Civil Engineers in January 1913, together with the discussion that followed its presentation. There is also, however, a description of the region at the head of the Gulf of California, by the late William P. Blake, who while connected with the Pacific Railroad surveys in 1853, made the first scientific study of the region. Then follows a summary of various facts regarding the region, abstracted by the author from various scientific monographs, also a description of the watershed of the Colorado river. The reprint of Mr. Cory's paper follows. As most engineers will remember, this paper discussed the shortage of water that induced the California Development Co. to make the cut that it seemed for a time would result in permanently diverting the Colorado river. The paper then describes the various unsuccessful attempts to close the break and the final closing, together with the means taken to prevent a recurrence of the trouble. Most of the men who were connected with the work itself as well as many other prominent engineers, participated in the discussion of the paper. In closing, the author summarizes the events that have taken place since the appearance of the paper.

Commercial Paragraphs

Three additional 10 ft. by 48-in. Hardinge mills have been ordered by the Anaconda Copper Mining Company.

The Connersville Boston type blower, for flotation and other high-pressure service, is described in Bulletin 23 of the Connersville Blower Co., Connersville, Indiana. Some notes are also given on the valveless rotary vacuum-pump.

The Georgia Slide mine at Georgetown, Eldorado county, Cal., has ordered equipment for development including air-compressor, rock-drills and sampling-plant. This property has a big low-grade body of gold ore and promises to be a good-sized proposition. Robert E. Cranston of San Francisco is in general charge of developments. More equipment, such as permanent mill and buildings may follow later.

'Cooling-Ponds for Condensing-Engines' is the title of a paper read by Lee H. Parker, president of the Spray Engineering Co., Boston, Mass., before the National Association of Cotton Manufacturers, at its 99th meeting, New London, Conn., on September 11. Pollution of river water by waste products from manufacturing processes led to the English practice of constructing cooling-ponds for the circulation of hot water from condensers. The water current was diverted by various means. Then natural-draft cooling-towers were developed, the water gradually dropping through a series of shelves or floors. The spray-cooling system next came into use, in which the hot water is forced through nozzles, thus coming in contact with sufficient air to cool it. The spray-nozzles are the most important feature of this system, for which several advantages are claimed over towers of good design.

Robert E. Cranston has been appointed consulting engineer for the design of a new gold dredge to be built for the Chiksan Mining Company, Chiksan, Korea, by the New York Engineering Co. The Chiksan Mining Co. is an American-Japanese enterprise that has been operating lode mines in Korea for some time, this being its first dredging venture; J. R. Geary of Yokohama is president. The dredge will cost approximately $250,000 and will take several months to build. As special features it will have a by-pass for clay (some clay being anticipated in the gravel), and there will be also a special re-soiling arrangement designed by Mr. Cranston. The dredge will have a steel hull 110 ft. long by 50 ft. wide by 10 ft. deep; buckets will be 10½ cu. ft. to dig 25 ft. below the water-line with 15 ft. bank; a revolving screen; it will dig with spuds or headline; a 60-hp. boiler will heat water on the dredge, and in the pond on account of the freezing weather occasionally experienced in Korea; the hull and machinery without electric equipment will weigh 1100 tons.

Two new booklets, Forms 76 and 9201, have been issued by the Ingersoll-Rand Co., 11 Broadway, New York. The former's title is 'Water Lifted by Compressed Air.' It is a treatise on the air-lift and explains this system of pumping. All those interested in adequate water-supply will appreciate this booklet, since it very intelligibly presents facts essential to the analysis of a scheme involving the use of clean water in quantity. The other publication is a 128-page 6 by 9-in. catalogue on Calyx core-drills. The principal function of this drill is the determination of the character, order, thickness, and extent of the materials beneath the earth's surface, by means of cylindrical cores which it extracts. In coal and metal mines, stone quarries, contract work, or for canal or tunnel developments projected, the core-drill is used, and is claimed to take what is otherwise an unknown quantity and converts it into an absolute certainty. By determining the actual conditions in advance, it is a medium to save a large sum in machine equipment, underground workings, etc., that might otherwise be expended only to find a barren property. The booklet is illustrated, gives size and capacities of the different types, and shows the apparatus in operation in various fields.

EDITORIAL

T. A. RICKARD, Editor

SPEAKING of 'horses' in schist, we are reminded of the story told of Clarence King. He had a call to examine a mine in which a 'horse' had spoiled the ore-shoot. He went, and telegraphed saying: "Your mine is a livery-stable."

WE UNDERSTAND that the decision of the District Court of Delaware in the Minerals Separation *v.* Miami lawsuit will be handed down during the current month. The Supreme Court decision on the final appeal of the Butte & Superior is expected in the spring.

PREPAREDNESS will require the consumption of much metal in the manufacture of munitions. The mining industry is an important factor in facilitating such 'preparedness.' Fortunately the United States can supply the various metals required for military or naval construction, all save nickel, and a supply of that is available just across our northern border.

SUPPLEMENTING the note in our last issue, we are able to state that Mrs. Carrie Jane Everson, who patented the essential principle of flotation 29 years ago, died at San Anselmo, California, on November 3, 1914, at the age of 73 years. She left Denver in March 1909 and lived in California during the last five years of her life. Mrs. Everson was not a school-teacher, her brother was not an assayer, and she did not make the discovery while "washing greasy ore-sacks" as has been reported repeatedly.

IN a suit now pending in London over apex-rights in Rhodesia, the novel plea was put forward that the reports made to a mining company by its engineer were not necessarily accepted by the directors as true, "but merely as statements of what is probably happening." Of many Rhodesian reports it may be said, of course, that they reflected improbable developments, but as they were given by the directors to the shareholders in the guise of accurate—even meticulously accurate—information, it comes with poor grace from them now to refuse to allow the reports to be used as evidence in Court.

ONE of the curious consequences of the War is the suggestion to ship the zinc-lead ore of the Bawdwin mines, owned by the Burma Corporation, from the Northern Shan States—where these mines are situated—to Australia. A favorable consideration of the proposal to establish a smelter for this purpose in Australia is assured by the Premier of the Australian Commonwealth. It is estimated that the Bawdwin mines can produce 75,000 tons of lead, 65,000 tons of zinc, and 7,000,000 ounces of silver per annum. Just before the outbreak of hostilities in Europe, the zinc-lead ore, which resembles that of Broken Hill in being an intimate and refractory mixture, was being shipped tentatively to Germany. Since then an effort has been made unsuccessfully to obtain satisfactory reduction facilities in England.

GOVERNMENT aid to mining is not unknown in the older mining regions of the world. It comes usually as a belated recognition of the importance of the industry. We note that the Government of New South Wales has subscribed $200,000 to the fund of $510,000 being raised by means of receiver's certificates for realizing upon the ore and other assets of the Great Cobar copper mine in New South Wales. If the Government had given a friendly hand or lifted a warning finger during the earlier days, when labor shortage and reckless promotion joined in bringing the enterprise to a pitiful collapse, it would have been better for the shareholders and the State.

A DIFFICULT shaft-sinking problem is always interesting. The description—appearing in this issue—of sinking through broken rock against high water-pressure was written by the assistant-superintendent for the Cleveland-Cliffs Iron Co. in the Gwinn district. Accounts of sinking through quicksand by using the caisson method, so that no pumping is done, the sand and water being held back by compressed air, have appeared in previous numbers of the MINING AND SCIENTIFIC PRESS. The article describes a method employed by the mining company to continue the sinking after the shaft had been sealed to bedrock by the Foundation Co. As no pumping had been done in the 100 ft. of sinking to bedrock, it is obvious that the thick overburden must have contained a tremendous body of water, it being remembered that the soil in northern Michigan is Glacial drift with a tendency to hold moisture. It may be asked why ordinary methods of sinking and pumping were not adopted, merely lining the shaft through the broken rock with a tight concrete wall; but how could the concrete be placed in position against a flood of water that would rush from the rock in torrents? A consideration of the problem shows the advantage of the method used.

FROM LONDON we hear that the Tomboy Gold Mines, operating at Telluride, Colorado, is well pleased with its recent purchase of the Sidney-White Cloud group of claims, situated north of the Bushwhacker claims and covering 4000 feet on the Montana vein. The price was

$75,000, which is small, having regard to the enlargement of the company's resources ensured by the transaction. This is the third or fourth time that the life of the Tomboy property has been usefully prolonged. When we remember what a disappointment the original Tomboy mine proved itself, and how the fortunes of the company were retrieved by the purchase of the Argentine, and how the Argentine was replaced by adjoining property when it also was exhausted, we conclude that the shareholders of the Tomboy have much reason to be grateful to their directors, particularly Messrs. R. T. Bayliss and J. H. M. Shaw, and to their successive mine managers, the two Herron brothers. Evidently the directors of the Tomboy regard themselves as trustees for the shareholders and not as privileged speculators on their own account. We hope the example will prove contagious in London.

SILVER, much to the delight of the miner, has risen from the low level of 46¾ cents on August 25 to 56½ cents per ounce during the past week. This has caused particular rejoicing not only at Tonopah and Cobalt, but also in Colorado, the Coeur d'Alene, and throughout the West. The reason for this rise is the withdrawal of gold from circulation, owing to the War, and the greater need for silver in metal currency, to sweeten fiat money. The United States produces one quarter to one third of the world's annual output of silver, but North America as a whole ordinarily produces nearly three-quarters of the grand total. The European governments are keeping a tight hold on gold. Meanwhile India, which is a veritable maw for silver, absorbing 55% of the world's annual output, continues to call for both silver and gold. The natives of Hindostan learned many years ago to hoard gold, rather than silver, for the Government levies an import-tax on silver, while admitting gold free. During the past three years 30% of the world's gold production has been going to India, while elsewhere the people usually described as more civilized have been learning to lay aside wealth in paper credits, doing business in notes, debentures, and bonds. Recently the demand for silver from China has improved and the renewal of trade prosperity in the United States has revived the consumption of the metal in jewelry—a sure index of better times.

AS our readers are aware the word 'mine' is derived from a Roman military term, since mining and sapping under fortifications played a greater part in the ancient world than the digging for metals. In these days of supposedly advanced civilization the term has resumed much of its former meaning, for 'mines' imperil navigation no less than they endanger the movement of troops on land. Hence it is not surprising that the mining engineer should be called from his peaceful and beneficent occupation of excavating ore underground to the destructive operations of the battlefield, where he is now engaged in digging tunnels to undermine the enemy's trenches or in counter-sapping similar efforts of the opposite side. The mining engineers in the Allied army are doing their work well, as becomes professional men. We note that Sir John French has 600 mining engineers among his forces. In a recent dispatch to Lord Kitchener he says: "I desire to call your lordship's attention to the splendid work carried out by tunnelling companies. These companies, officered largely by mining engineers and manned by professional miners, have devoted themselves whole-heartedly to the dangerous work of offensive and defensive mining, a task ever accompanied by great and unseen dangers." We do not doubt that the engineers graduated from Freiberg and Clausthal are doing their best for the other side, and we only regret that members of a world-wide profession should have to kill each other in order to prove which school of political thought is the better.

Drill-Steel

The captains of modern industry know the economy of using the best tools. Of the total cost of mining, fully 65% is represented on the pay-roll, that is, by wages paid to workmen. Time is money; the saving of time through the use of the most efficient tools is axiomatic. The miner is an instrument of industry, deputed to perform a given task; therefore it behooves the employer to render that instrument as effective as possible. One way is to make him physically fit and mentally comfortable. Hence the welfare movement. Another way is to supply him with the best tools that money can buy. The point of mining is the drill. That implement, driven home by air, steam, or muscle, does the work whereby the metal-bearing rock is broken so that it can be moved from its place underground to another place where it can be subjected to the successive reductions and treatments that finally separate the valuable metal from the valueless gangue. To make a drill and a drill-bit that will stand the strain of rapid concussion without displaying either shortness of temper or 'fatigue' is the aim of the mining economist. Of late, the tendency has been to focus attention on the drill as a machine, while overlooking the improvement of the steel in the bit that constitutes the business end of the mechanism. This fact was emphasized lately in an excellent article by Mr. L. O. Kellogg in the *Engineering Magazine*.

One of the many advances in drilling during recent years has been effected by the introduction of hollow steel, whereby water is admitted in such a way as to allay the deleterious dust and remove the rock-chippings. With the use of hollow steel has come also the rapid introduction of the hammer type of drilling machine, in preference to the older type that derives its impulse directly from a piston. The hollow steel of the hammer-drill is subject to excessive strain by reason of the high speed, which in some cases reaches 1500 blows per minute. Only the best quality of steel is fit for this service. Moreover, the critical factor in the business of supplying drill-steel to mines is not the first cost but the unit cost—the cost per ton of ore mined. In this cost the expense of the steel is only one item. The expense of sharpening, the loss of time in changing bits, and in taking them to

the blacksmith are among the other items to be noted.

Competition between domestic and foreign steel is another interesting phase of the problem. The salesman will tell you that Swedish steel is made from a purer and more homogeneous ore than any to be obtained in the United States, and he will assert that it is manufactured by workmen more skillful and more experienced. The American salesman will belittle such claims, insisting that his firm has beaten the Swedes at their own game by methods evolved in a research laboratory, and that, although the Swedish steel happens to be cheaper in first cost, this is due to cheap labor, rather than any superiority of manufacture. The fact is that Sweden does possess a supply of ore peculiarly free from phosphorus and sulphur. No coking-coal exists in their country, so that smelting by means both of charcoal and of electricity has been developed. The abundant water-powers of Scandinavia have stimulated the use of the electric furnace. This method of making high-grade steel is superior to processes using coke, which tends to introduce its sulphur into the iron from which the steel is made. At the famous electric plant at Trollhättan, the ore mixture contains 63% iron, 0.01% sulphur, and 0.015% phosphorus. A much larger electric furnace has been started recently at Domnarfvet, where 10,000 horse-power is consumed as compared with the 2500-hp. furnace at Trollhättan. It is claimed that the average iron ore from the Swedish midlands runs between 0.005 and 0.02% in phosphorus and between 0.005 and 0.05% in sulphur, and that in the concentration by the Gröndal process ore containing as much as 1% phosphorus is refined to a concentrate much of which contains less than 0.01% of either phosphorus or sulphur. The greater part of Swedish soft, or mild, steel is so free from these two deleterious elements that large round bars when cold can be tied into knots without sign of fracture. The iron and steel output of Sweden is not large; the aim is said to be the production of quality and high-grade variety rather than tonnage. Labor in Scandinavia is relatively docile and cheap, and the easy access to tide-water facilitates maritime transport. So much for the Swedish steel.

Americans have awakened to the opportunities afforded by the market for high-quality tool-steels, which are being manufactured at a rapidly increasing rate. Most of the output is for domestic consumption. One enterprising company that formerly imported Swedish steel is now making its own material in a New Jersey factory. Americans have also adopted the electric furnace, and when our people once catch the idea of a process—for example, flotation—they soon ascertain the essentials in the method of the other fellow and add improvements of their own that accomplish astonishing industrial results. The great advantage of the electric furnace is the facility for perfect control of the heat, so that just the proper temperature for just the right time can be maintained, as against the older methods with their uncertain conditions. The electric furnace as a factor in steel-making has been so recently perfected that it may be doubted whether the Swedes, even with their long experience in iron-working, have any substantial advantage over our more progressive manufacturers. As to the purity of ore, this country possesses several iron deposits that are well adapted for the purpose.

There is also the question of alloys. Hitherto, drill-steel has been little more than a high-carbon product, specially treated, the carbon content usually being from 0.70 to 1%. Alloy-steel has been so expensive and so little appreciated that its use in drills has made slight progress. Furthermore, the average mine-blacksmith, whose task it is to sharpen the drills, has usually lacked both the time and equipment for treating special brands of steel properly. Nowadays, however, progressive mining companies are installing mechanical sharpeners, which not only achieve a substantial saving in the cost of sharpening, but produce a more uniform bit. Of course, while the War lasts, the price of some alloys will be prohibitive. Thus, tool-steel containing 18% tungsten is selling at $2.50 to $3 per pound, while molybdenum alloys are equally high-priced. On the other hand, search is constantly being made for such alloy-components, and it is reasonable to expect that before long the United States will not have to depend upon foreign sources of supply. At present a great diversity of opinion is manifest as to the actual functions of the alloy components, such as chromium, manganese, tungsten, and others. One manufacturer claims that he can adapt a high-carbon steel to hard-rock drilling by merely adding manganese, to lessen brittleness and give the toughness that has caused low-carbon steel to be required for such work. There is no doubt that the War has afforded the manufacturer an excellent opportunity to show what he can do for the miner in this respect.

Electro-Statics in Flotation

In this issue we publish the text of a paper read by Mr. J. M. Callow before the Salt Lake section of the American Institute of Mining Engineers on October 4; the delay in publication arises from the fact that the paper was not 'released' until it had been printed for the December bulletin of the Institute, at New York. The detailed description and drawings of the pneumatic cell, designed by Mr. Callow himself, will be welcomed by those interested in flotation—and who among millmen and metallurgists is not? The flow-sheets outlining the various schemes of treatment adopted by the National Copper, Inspiration, Arizona Copper, and Daly-Judge companies will prove suggestive. But the most interesting portion of the paper is the discussion of the principles underlying the obscure phenomena of flotation, more particularly the electro-static characteristics of the ores that are most amenable to the process. That floatable minerals exhibit evidence of being charged electro-positively, while the non-floatable gangues show corresponding signs of negative electrification, is a fact of fundamental importance, indicating a promising line of research. It appears likely that flotation is due in part,

at least, to the difference of polarity in the charges on particles of ore and on the bubbles that convoy them. The contact films both of oil and of air having been proved to be negative, it is easy to understand why the positively-charged metallic sulphides should adhere to either of them. This development of theory is a direct result of the study of colloids. As Mr. O. C. Ralston states, it simply became a question whether the effect of electrolytes on colloids could be duplicated to a measurable degree on relatively coarse suspensions of ores such as are treatable by flotation. It has been suggested that the friction engendered during the agitation of the pulp served to generate the electric charges, but colloid chemistry indicates that such charges are created whenever two substances of unlike dielectric constants are brought into contact. In the article by Mr. Thomas M. Bains, Jr., appearing in our last issue, this phase of the subject was discussed in an informative manner. Not only friction, but differences of temperature, cause electrification. That may be one reason why the increased revolutions of an agitator are favorable to froth-concentration in the flotation-cell. The relatively high electric conductivity of the floatable minerals is also suggestive: so is the effect of adding acid. It is worthy of note that the electric explanation of flotation has been taught in the Case School of Applied Science, by Mr. Bains and his chief, Mr. Charles H. Fulton, professor of metallurgy, for fully a year. Researches along this new avenue of scientific enlightenment are being made by the U. S. Bureau of Mines, to the Salt Lake branch of which the industry is already under great obligation for illuminating information.

Individualism and Co-operation

It was pointed out by Mr. L. D. Ricketts in his recent address at the Exposition that the tendency in the United States during the extraordinary industrial development of late years has been toward the limitation of the individual and the concurrent utilization of the power of organization. Mr. Ricketts said: "To accomplish results the individual has had to recognize the necessity for the association of a great variety of talent exercised by a large number of men into a working organization of ability, courage, and spirit." This statement embodies the very essence of modern American business; namely, the willingness to surrender some measure of individuality in order to attain the efficiency required for success in commercial competition with the remainder of the world. Somewhat the same idea is conveyed in President Wilson's popular little book, 'When a Man Comes to Himself.' Mr. Wilson states that the old idea of a man having to live apart from the world in order to obtain the fullest expression of his power has now been superseded by recognition of the fact that a man in constant contact with associates is aided by suggestions, hints, and mental stimuli, combining to furnish him with incentive and opportunity to work effectively. The reason that Americans, who pride themselves particularly on the achievement of liberty, have submitted to the routine and discipline of organization in industry is that they appreciate the superior efficiency of team-work as compared with striving at cross-purposes. Thus has come 'big business,' and the present remarkable exploitation on a huge scale of those low-grade resources that could not be profitably operated in a small way. Americans are notable organizers, promoters, and advocates of the 'work together' idea—at least, in business. Industrial wonders have been accomplished by utilization of this power of organization.

Danger comes from believing that organization is everything: that individual initiative and spontaneity are to be disregarded. Bureaucrats, who delight in corporation politics and petty officiousness, are an example of organization run to seed. Occasionally expression is given to the distorted belief that an organization for this or that can do everything; which it cannot. An organization to make Chicago the art centre of the world, instead of Paris, would fail because art is not manufactured like breakfast-food or soap; individual talent is necessary, as also the state of mind growing out of many generations of belief in art for its own sake. Likewise an organization formed for the purpose of inventing an improved rock-drill or concentrator might fail miserably, while a clear-thinking young miner or millman, of whom no one had ever heard, might succeed in producing exactly the design sought. The point is that a sense of fitness should govern; and that brains, understanding, and genius—erratic and individual as it usually is—should be given encouragement. It is likely, if the great inventors and discoverers of history had been compelled to work under the handicap of particularly overbearing discipline, that they would have been only second-rate mechanics or clerks. A company that loses sight of the necessity for giving scope to individual spontaneity and independent thinking, while devoting all its energy and attention to organization, will soon come to grief. Not infrequently we see capable men, having been discharged or overlooked by one company, going into business for themselves or some one else, and promptly take away trade from the organization that was too dull-witted to recognize their ability.

The reason why a corporation should encourage individuality and thereby loyalty in its members, giving scope to personal ability whenever possible, is because, as pointed out in a publication of the W. S. Tyler Company of Cleveland, "in the final analysis every organization consists of but one man." Frequently at a mine the responsibility of the organization rests upon the hoistman in the engine-room, as when, for instance, he is lowering the directors or management down the shaft. The critical point in every important negotiation—the deciding element that makes the little difference between failure and success—is the influence and personality of one man. It may be, and frequently is, a different man on different occasions, in the same corporation, but the human note counts and is an unquestionable factor in every final analysis. It always will be.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Law and Patents

The Editor:

Sir—Your editorial discussion of this subject in your issue of November 6, appears to be somewhat superficial, and your conclusion that "the patent law is an excavated anachronism" seems to be without sufficient basis. The American patent law, on the whole is good, but that it might be improved, no one will deny.

Your statements, in the article referred to, or their equivalents, have so frequently appeared in the technical press, that I cannot resist challenging them every time I see them. I will, however, consider only three points in your discussion.

First; you say: "Manifestly the Government should not grant the privilege (a patent) without thorough investigation." Are your readers to understand from this, that before a patent is granted, you would put every inventor to expensive litigation? If not, what is a thorough investigation? You mention publicity; but it is an old saying that "What is everybody's business is nobody's business." Who, for example, if your suggestion for publicity were adopted, would have presented the evidence for the public and prior inventors at the time patent No. 835,120 was filed? Remember, at that time there was very little interest in flotation matters, and its possibilities were not realized. Then, if no one had adequately defended the public and prior inventors, the patent referred to would have been granted, as it has been granted under present conditions. Then, are we to understand, if the patent had been granted under your suggestions, that the public and prior inventors should be deprived of all that had been disclosed in the prior art because the public was not adequately defended?

There would be no end of injustice in such a case, both to the public and prior inventors. The latter would be systematically robbed under the guise of legality and litigation, and there would be no redress, once a patent is granted. Manifestly, the only investigation which would be applicable under your suggestion would be litigation, for that is the only way evidence could be adequately presented. Would you force every applicant for a patent into such litigation, both in obtaining a patent, and later, in repeatedly defending it against subsequent applications? Is not the present scheme infinitely better? Under the present system, if there is any reasonable doubt in the mind of the examiner as to the issuing of a patent, the applicant is given the benefit of the doubt, and he can then defend his position in the courts if occasion requires, and, after all, the courts should be the final arbiters in patent cases as in all other cases. Justice is not always made easy, and in the courts new evidence may affect past decisions. Let us bear in mind, that even with all the evidence presented in the flotation litigation, at an expense of many thousand dollars, there is no unanimity of opinion; one court decided in favor of the plaintiffs, and one for the defendants. How, then, would your scheme help matters? The examiner of patents is not to blame for being in doubt, when the courts and all the experts, both technical and legal, with all the present evidence, find difficulty in arriving at a just decision. All your scheme would do, would be to compel every applicant to litigate, and no patentee would at any time be safe.

Second; "Next, it (the Government) should assume the duty of specifying the proper royalty to be collected by the patentee, modifying the impost from time to time according to circumstances and preventing an excessive imposition." This, of course, is the socialistic solution of the difficulty, and no fault can be found with it. The Government should, perhaps, also adjust the various conflicting interests without expensive litigation. Nothing is so new but that it embodies something that is old, and nothing is so old but that it may embody something new. This is clearly the case in the flotation situation. But, let me add with extreme emphasis, if such a socialistic supervision of patent privileges is advisable, it would follow that all products from patented apparatus or processes should be similarly regulated by the Government. Surely you would not be so uncharitable as to advocate the Government regulation of patent royalties, and leave the patentee and the public to the tender mercies of private regulation of the products produced under Government regulation of patents. Let us try and be fair.

Third; "Many patentees—including some of those privileged to use certain phases of flotation—take care to give as little information as possible. * * * This failure to give explicit information marks an effort by the patentee to protect himself in default of protection from the Government." I doubt this explanation: It will probably not apply once in a thousand times. The true explanation is that the patentee himself never realizes the scope of his invention and the best method of carrying it out, at the time the application for patent is filed, and the conditions are such that he cannot realize its scope. An invention, at the time of filing application for patent, is not a finished product: it is merely a beginning. In mining parlance, it would be termed a

prospect. An inventor, as a rule, knows no more of the value and scope of his invention, than a prospector does about a newly located mining claim. The two cases are parallel. As either the prospect or invention is developed, its value becomes more fixed; if it is not promising it is abandoned; if promising, it is developed as far as the outlook is encouraging. Either prospector or inventor may strike it rich; either may go broke. The work and expense of a patentee, in developing his invention, is just as great and just as real as the work and expense in developing a prospect. But, through it all, the prospector does not wait to develop his claim into a mine before he files his location certificate and gets possession; neither does an inventor. The prospector's title is absolute if properly filed; an inventor's rights cannot be so well defined, and it is for this reason, as well as others, that courts have rightly given the broadest interpretation to pioneer patents. So, let us not criticize patentees, or the patent law, for something which in the very nature of things cannot be remedied. The inventor who would wait until he can clearly define the scope of his invention and the best method of carrying it out before filing a patent application, would be a fit subject for the insane asylum. It is for this reason, also, that publicity of patent-applications would amount to positive confiscation and robbery. Instead of greater publicity, more secreey would be the inevitable result. Every inventor's honest efforts should be kept secret until he, himself, desires publicity. If patent-application were given publicity, applications would be delayed in filing, and in case of a contest to determine priority, the result would be that the evidence would be obscure and intangible, as compared with the definite filing-records under the present system. Secrecy, necessarily, goes with the development of an invention.

W. E. Greenawalt.

Denver, November 13.

Mining Accidents

The Editor:

Sir—I am a miner of many years of underground experience, in the various sections of the metal-mining countries of the West. The questions of health and accidents in your pages have prompted me to make a few statements. Some writers in your publication have gone so far as to make no allowance or distinction, but go ahead and stigmatize miners in general as a reckless, careless, and untrustworthy lot. The writer would enjoy having such a man as Harry L. Day and his ilk in some of the gas-polluted holes performing a task with the aid of a companion who could not speak the language of the country; or to see him forced to climb broken ladders with pails of water and blasting material, being furnished neither means nor privilege of looking after safety without imperilling the privilege of laboring. Another thing I would like to see is a mining-magazine editor who is brave enough to collect some statistics on lung diseases caused from air-pollution by gas and dust; to describe the various poisons in the different ores when they are floated in the air, and to explain the function of the cilia of the lung and the effect on the aforesaid organism by the various forms of mineral-dust.

M. Smith.

Bisbee, Arizona, November 20.

[Our correspondent distorts the reference made to the cause of mine accidents; we did say that we had found miners to be "reckless," but we did not say that they were an "untrustworthy, etc.," lot. Mr. Smith will find an article on pulmonary disease among the miners of the Joplin district in our issue of November 27.—Editor.]

Who Owns a Report?

The Editor:

Sir—I note with much interest the editorial discussion on 'Who Owns a Report?' in your issue of October 30.

In dealings with clients I make it a practice not to use the information obtained from earlier examinations for the benefit of new clients, without first ascertaining whether or not my earlier clients are still interested in the particular property. If they are so interested I decline to report without their permission, but if they are no longer interested, then I feel free to use the information at hand.

In but one instance out of a large number of cases have I found clients at all inclined to a dog-in-the-manger attitude. In that instance the man who desired my services took the attitude that my report was his property, that I had no right to report upon the property for others, and that if anyone else desired a report upon the property he would sell the information to them, but I could not do so. Needless to say, I declined to be bound by such a procedure and flatly refused to undertake work upon such a basis.

I feel that knowledge gained in an examination is mine, and that only the particular report belongs to the client who secures it.

One must, to my mind, be guided by a sense of fairness and justice. If an engineer frankly asks his clients whether or not they object to his reporting on the same property for others, he will find in most instances a liberal attitude, and secure a free hand to report for others if the interests do not interfere.

The average business man does not want interference with his business, but I find that he is broad-gauged enough not to feel that he buys a man body and soul when he pays for a report.

Dorsey Hager.

Tulsa, Oklahoma, November 4.

Manganese ore is being imported from Brazil into the United States in increasing amount. During the month of August over 50,000 tons was brought in. The United States imported 283,294 gross tons in 1914, which was less than in 1913 and 1912, and of which India contributed 103,583, Russia 52,681, and Brazil 113,294 tons.

Notes on Flotation

By J. M. CALLOW

*Historical Sketch. The selective action of oil for lustrous minerals was first disclosed by Haynes in 1860. In 1885, Carrie Everson elaborated this idea and also disclosed the fact that acid increased the so-called selective action. Her patent called for oils, either animal, vegetal, or mineral, and also an acid or salt. The process was tried on a practical scale both at Baker City and Leadville in 1889; it failed, first, because, as has since been shown, of the unsuitability of the ore to flotation; second, because her invention was too far in advance of the times. Then followed the Elmore brothers, first with their bulk-oil processes and later with their vacuum scheme. The basic principles of oil-flotation were undoubtedly covered by the above inventors and the work that has been done since their time has been merely a building up on ground-work laid down by them. Different kinds of oil, different quantities of oil, and all the varying degrees of agitation were all exemplified and practised by them in one phase or another; the developments that have since been made are but elaborations of the fundamental principles laid down by Haynes, Everson, and the Elmore brothers.

In 1902 we saw the development of the Potter or Delprat process in Australia. In this no oil was used, but

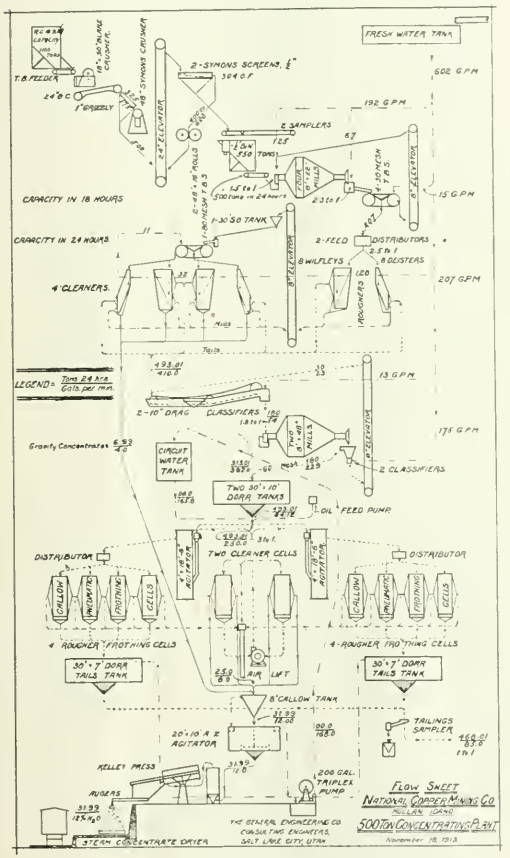


Fig. 1.

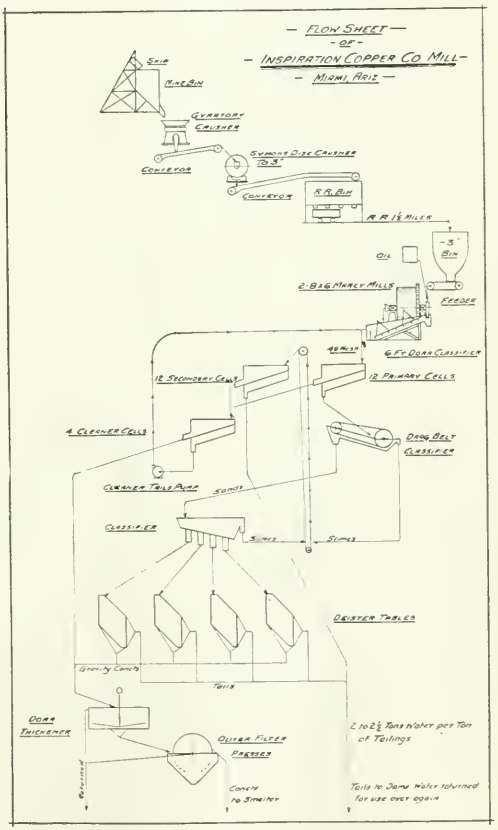


Fig. 2.

*A paper originally presented at the annual meeting of the Utah section of the American Institute of Mining Engineers, at Salt Lake City, on October 4, 1915. To be read at the New York meeting in February.

the mineral was raised by the generation of gas, brought about by the introduction of acid in the pulp so that the mineral appeared on the surface of the separatory vessel in the form of a scum or froth buoyed by minute gas bubbles attached to them, and thus first gave the suggestion of gaseous flotation. In 1902, also, Froment, an Italian, was granted a patent in which he combined violent agitation with oil and gaseous flotation, the gas being generated within the pulp, in much the same way as in the Potter-Delprat process. In the same year, Cattermole came out with a unique scheme. He first emulsified his pulp with a small quantity of oil by violent agitation and afterward submitted it to a slow stirring action in a second machine, by which he granulated or coagulated the minerals that had been oiled into nodules, which he afterward separated from the pulp by gravity. The defect of this process was that only part of the mineral was granulated, the rest of it appearing on the surface of the pulp as a scum or froth, and so was lost in the tailing. This defect of the Cattermole process suggested the fundamental idea of the process afterward described by Sulman, Picard, and Ballot in their patents, in which, instead of granulating part of the mineral, they floated all of it. This patent forms the basis of all the Minerals Separation operations. It was first exploited in Australia and in a short time replaced all other flotation processes in that country.

In 1904, MacQuisten brought out his tube process, a very ingenious scheme which gave excellent results on the sandy portion of the feed, but was inoperative when slime was present. This was a strictly surface-tension scheme, and its inability to handle slime was a serious limitation.

In 1912, Hyde introduced a modification of the Minerals Separation process into the mill of the Butte & Superior company, at Butte, Montana. This differed from the regular practice in that it introduced a double treatment, first 'roughing' and then 'cleaning' the concentrate.

Pneumatic Flotation. Early in 1909, I did a great deal of work with the MacQuisten flotation process and in the installation of the tube-plant of the Morning mill at Mullan, Idaho. This work was followed by a large amount of experimenting on the different kinds of existing flotation processes, the outcome of which was the development of the pneumatic method.

The first application of pneumatic flotation for the treatment of ore was made by me at the mill of the National Copper Co. at Mullan. This plant was designed and built by me and was a success in every way from the very start. Construction was started on August 14, 1913, and the plant went into successful operation about April 10, 1914. The flow-sheet is given in Fig. 1.

Since that date, the method has been adopted by nearly all the other mills in the Coeur d'Alene treating lead and lead-zinc ores, notably the Gold Hunter, Morning, Hercules, Bunker Hill & Sullivan, Caledonia, Last Chance, Hecla, Standard, etc., a total of about 50 cells in all, treating from 1500 to 2000 tons of slime and fine sand per day. The same method also has since been adopted by the Inspiration, Arizona, Anaconda, Magma, and other copper companies, and by the Silver King, Daly-Judge, Duquesne, and El Rayo mining companies, on lead, zinc, and other ores, making a total of some 680 cells in operation or in the course of erection, having a combined capacity of 25,000 to 28,000 tons per day.

The flow-sheets of the Inspiration and the Arizona Copper plants are given in Fig. 2 and 3. The Daly-Judge flow-sheet, in Fig. 4, is an interesting example of the recoveries possible on zinc-lead, fine sand, and slime.

The accompanying diagram, Fig. 5, illustrates the various elements composing the Callow method.

A is a mixer operated by compressed air for the purpose of mixing and emulsifying the oil, the air, and the water, the same type of apparatus being in common use in cyanide work. In cases where the oil or frothing agent can be fed into the crushing machine or tube-mill, this mixer, or Pachuca tank, can be eliminated, so that the oil is fed direct into the mill and thence into the separatory cell.

It has been proved conclusively that agitation *per se* is not necessary to successful flotation by the pneumatic method. In one of the plants a Pachuca mixer for each four roughing-cells was installed. This received the thickened feed from a Dorr tank, which feed was elevated by a belt-and-bucket elevator. The oil was fed into the boot of the elevator and the mixing there served all purposes, since the results without the Pachucas were found to be just as good as with them. Therefore the use of them in this plant has been abandoned.

B is the initial or roughing separatory cell. It consists of a tank about 9 ft. long over all and 24 in. wide, with a bottom inclined at from 3 to 4 inches of fall per foot; it is 20 in. at the shallow end and 45 in. deep at the deepest end. It may be built of either steel or wood, preferably wood.

Figure 6 shows the cell in detail. The bottom of the tank consists of a porous medium made of four thicknesses of loosely woven canvas-twill, properly supported by a backing of perforated metal to prevent bulging when under air-pressure. Through this porous medium compressed air is forced by the blower *E*. Porous brick or any other ceramic material may be used to ensure the necessary fine subdivision of the air. Some of these have been tried, but for practical and mechanical reasons the loosely woven canvas-twill seems to serve all purposes better than anything else, and has been adopted as the standard porous-bottom construction.

The space underneath this porous medium or bottom is subdivided into eight compartments, each connected by an individual pipe and valve with the main air-pipe *F*. By this means the air-pressure to each compartment can be regulated (by throttling the valve) to correspond with the varying hydraulic head within the tank, so as to discharge a uniform amount of air throughout the length of the bottom and maintain a uniform aeration of the contents. A pressure of from 4 to 5 lb. is generally used and each square foot of porous medium requires from 8 to 10 cubic feet of free air per minute.

Each longitudinal edge of the tank is provided with a lip and an overflow gutter for the reception of the froth to be discharged. The lower end of the tank is furnished with a spigot-discharge fitted with a plug-valve, operated by a float, for the purpose of maintaining a uniform water-level within the tank, thus in turn securing a uniform and constant discharge of froth under all the varying conditions of feed incident to practical milling operations. The water-level, may, of course, be varied; but it is usually maintained at about 10 to 12 inches below

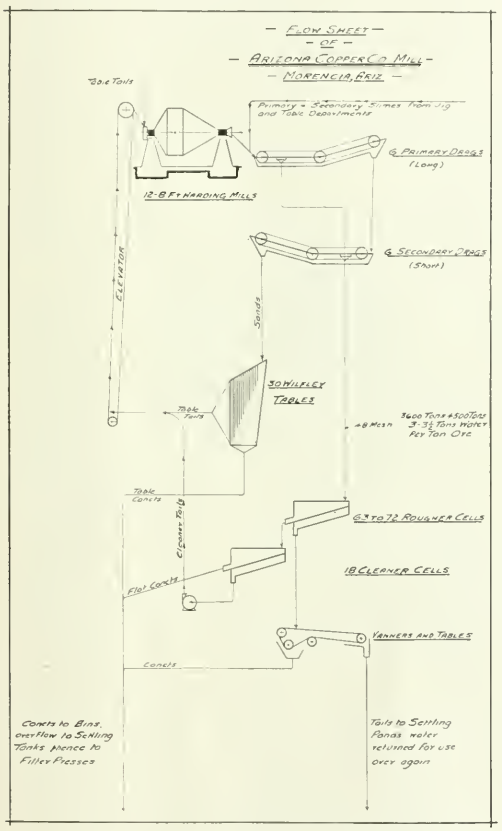

— FLOW SHEET —
— OF —
— ARIZONA COPPER CO. MILL —
— MORENCI, ARIZ —
To Tails
Primary & Secondary Slimes from Jig and Table Departments
6 PRIMARY DRAGS (Long)
12-8 FT. HARDING MILLS
6 SECONDARY DRAGS (Short)
ELEVATOR
SCREENS
30 WILFLEY TABLES
Table Tails
48 Mesh
3600 Tons 4 Spot Tons 3-3½ Tons Mixed Per Ton Ore
Table Concs
ELEVATOR No. 2
63 TO 72 ROUGHER CELLS
18 CLEANER CELLS
Float Concs
VANNERS AND TABLES
Concs
Concs to Bins, overflow to Settling Tanks thence to Filter Presses
Tails to Settling Ponds water returned for use over again

Fig. 3.

Parallel or Series. The machine may be run either in parallel or in series without any sacrifice in capacity for a given number of cells. Recent experience goes to show that, on some ores at least, the series treatment gives a slightly better tailing; on others it does not. It is unnecessary to extend this arrangement of cells beyond two cells in series. In a heavily mineralized ore this arrangement is decidedly advantageous and in such a case the rougher-concentrate might be of high enough

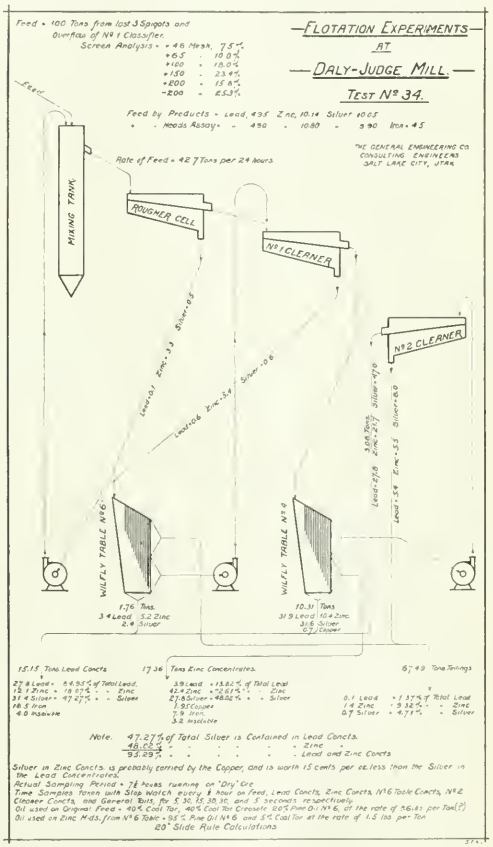

Feed = 100 Tons from last 3 Spigots and Overflow of No 1 Classifier.
Screen Analysis: +48 Mesh 7.5%
+65 : 10.0%
+100 : 15.0%
+150 : 23.4%
+200 : 15.8%
-200 : 28.3%
—FLOTATION EXPERIMENTS—
AT
—DALY-JUDGE MILL.—
TEST No 34.
Feed by Products - Lead .495 Zinc 10.14 Silver 10.65
" Heads Assay " - 490 - 10.80 - 3.90 Iron 4.5
THE GENERAL ENGINEERING CO CONSULTING ENGINEERS SALT LAKE CITY, UTAH
Rate of Feed = 42.7 Tons per 24 hours
Feed
MIXING TANK
ROUGHER CELL
No 1 CLEANER
No 2 CLEANER
WILFLEY TABLE No 6
WILFLEY TABLE No 9
1.76 Tons 3.4 Lead 5.2 Zinc 2.9 Silver
10.31 Tons 31.9 Lead 10.4 Zinc 3.16 Silver 6.7 Insol
15.15 Tons Lead Concs.
27.8 Lead + 8.4 %% of Total Lead.
12.1 Zinc + 19.07 % " Zinc
31.4 Silver + 47.47 % " Silver
18.8 Iron
4.0 Insolubles
17.36 Tons Zinc Concentrates.
3.9 Lead + 13.82 % of Total Lead
42.9 Zinc + 72.61 % " Zinc
27.8 Silver + 48.02 % " Silver
1.95 Copper
7.9 Iron
3.2 Insoluble
67.49 Tons Tailings
0.1 Lead + 1.37 % of Total Lead
1.4 Zinc + 9.32 % " Zinc
0.7 Silver + 4.71 % " Silver
Note. 47.27% of Total Silver is Contained in Lead Concts.
49.65 % " " " " " Zinc
93.29 % " " " " " Lead and Zinc Concts
Silver in Zinc Concts. is probably carried by the Copper, and is worth 15 cents per oz less than the Silver in the Lead Concentrates.
Actual Sampling Period = 7½ hours running on "Dry" Ore
Time Samples taken with Stop Watch every 1 hour on Feed, Lead Concts, Zinc Concts, No 6 Table Concts, No 2 Cleaner Concts, and General Tails, for 5, 10, 15, 20, 25, and 5 seconds respectively
Oil used on Original Feed - 40% Coal Tar, 40% Coal Tar Creosote 20% Pine Oil No 6, at the rate of 3.6 lbs per Ton(?)
Oil used on Zinc Mids. from No 6 Table - 85% Pine Oil No 6 and 15% Coal Tar at the rate of 1.5 lbs per Ton
20° Slide Rule Calculations

Fig. 4.

the level of the overflow-lips. The tailing is discharged through the spigot and the frothy concentrate is conveyed by means of the side-gutters to the pump *D*-1, thence to the cleaner-separatory cells marked *C*. This cleaner-cell is a machine of the same construction as the rougher; in operation, however, it is usually run with a lower air-pressure; the tailing from the cleaner is pumped by *D*-2 back to the original feed, and thus a closed circuit is maintained on this portion of the feed. The concentrate from the cleaner is the shipping or finished product. Pump *D*-1 can well be eliminated by setting the cleaner at a lower elevation and conveying the rougher-froth to it by gravity. Usually one cleaner serves four roughers.

grade to omit the re-cleaning operation. The froth from the second cell in the series might be returned into the original feed in the same way that the tailing is returned from the cleaner when practising a roughing and cleaning operation. A number of such combinations is possible. At the Inspiration, the original feed goes to 12 primary roughers, the tailings from which are classified into sand and slime, the sand going to tables and the slime being returned to 12 secondary roughers. The concentrates from both the primary and secondary roughers go to four cleaners, and the cleaner-tailing back into circuit.

Froth Formation. The froth is generated as the re-

sult of injecting the finely divided air into the bottom of the already emulsified pulp; it continues to form and to overflow so long as it is furnished with pulp of the proper consistency, properly mixed with the right quantity and kind of oil or frothing agent. Measured from the water-level within the tank, the froth produced may be from 14 to 16 inches in depth or thickness, and according to the character of ore, kind and quantity of oil introduced, will be more or less voluminous, coarse or fine grained, dry or watery—all of these conditions being adjusted by the regulation of the kind or quantity of oil and the quantity of air injected.

In the case of some ores, rich in sulphides, when a comparatively low-grade concentrate will suffice, the 'cleaner' may not be necessary, but on low-grade ores having a high ratio of concentration and demanding a concentrate of maximum purity, a cleaner is desirable.

Pulp-Density. The pulp to be treated may be of varying density, from 2½:1 water and ore, up to 5 or 6:1; for a mixture of sand and slime the former ratio is preferable, but for a pure slime mixture (–200 mesh) the larger proportion of water is allowable. The particular density is not a matter of so much importance as that the supply of pulp be uniform in density, since each variation in the density of the pulp requires a re-adjustment of the oil-supply, the quantity of oil increasing in proportion to the increased volume of pulp, independent of its solid content.

Capacities. A normal capacity per standard roughing-cell is 50 tons per 24 hours. This, of course, will vary with the nature of the ore. In one plant that employs gravitation previous to flotation the fine sand and slime only are treated at the rate of 50 tons per rougher. The Inspiration Copper Co. uses flotation as the prime process, and its 800 tons per section is treated by 24 roughing-cells and 4 cleaners. In this case the cells are run in series, the primary cells treating the original feed and the secondary cells re-treating only the slime from the primary tailing after the sand has been removed. This gives an average of 33.3 tons per roughing-cell. The Arizona Copper Co.'s plant will treat the slime and re-crushed sand from previous gravity-treatment; out of an original tonnage of 4000 there will be about 3600 tons of flotation feed. This will be handled on 63 roughers run in parallel, and 18 cleaners, or an average of approximately 57 tons per roughing-cell, or 45 tons per cell for roughing and cleaning.

Some tests have shown little difference in recovery, whether running 45 tons to the cell or 65; but the recoveries commence to decline as soon as the feed exceeds 75 tons. In the Coeur d'Alene, on zinc-lead ore, 35 tons per cell is an average capacity.

Oils. The oils used may be broadly divided into 'frothers' and 'collectors.' The pine-oils are good frothers; coal-tar and its various subdivisions are good collectors. On some ores crude pine-tar will in itself combine both the properties of frothing and collecting. On others, this may have to be enriched by the addition of some one of its more volatile constituents, such as refined pine-oil, turpentine, or wood-creosote.

Generally speaking, the coal-tar products are poor frothers; to get a sufficient volume of froth to insure a high recovery, it is often necessary to add refined or crude pine-oil, creosote, etc. At the Inspiration, for instance, the mixture is 80% crude coal-tar, 20% coal-tar creosote; at another plant on similar ore 45% El Paso coal-tar, 40% coal-tar creosote, 10% cresol, and 5% pine-oil. At the Daly-Judge we used 40% crude coal-tar, 40% creosote, 20% pine-oil. In the Coeur d'Alene on zinc ore we used straight wood-creosote; on the National Copper ore plain turpentine will work, but pine-oil is better. At the Inspiration we used from 1½ to 2 pounds of the mixture per ton of ore; at the Daly-Judge, 1 to 1½ lb.; and at the National 0.3 lb. oil is sufficient. In the experimental work at another plant the consumption of oil was approximately one pound of mixture per ton, but since the entire plant has been in operation and the circuit-water is reclaimed and used over again, the oil consumption has dropped from 1 to 0.35 lb. The proper kind or kinds of oil and the quantity requisite can only be determined at present by tentative experiment; so far no scientific short-cut is known.

Character of Froth. The nature of the froth made by the pneumatic method has the distinctive characteristic of being unstable or ephemeral, that is, it quickly dies when removed from the action of the injected air. The bubbles composing the froth, being generated under a hydraulic pressure varying from 15 to 40 inches, on rising above the water and to the froth-level, burst by reason of the lower surrounding atmospheric pressure. On bursting, they release the mineral attached to them, but this in turn is caught up by those bubbles immediately following behind. The instability or stability of the bubbles will depend, to some extent, upon the oil used and the nature of the gangue. Pine-oil makes a very brittle froth, which dies immediately on arriving at the surface. Creosote and light oil make a more elastic envelope, which at times will expand into bubbles 3 to 4 inches in diameter before bursting. The pine-oil bubbles will rarely be over ¼ or ½ inch diameter. Castor-oil, olive-oil, candle-makers' oil (oleic acid), palm-oil, sperm-oil, and other oils of a lubricating nature, have in general been replaced by oils more or less soluble or miscible in water—such as turpentine, pine-oil, and all the coal and wood-tar distillations. The very volatile oils, such as naphtha, gasoline, ether, alcohol, seem to serve very little purpose except as a means for making the pitchy ingredients of the tars more soluble or miscible.

A large, coarse, and elastic bubble seems necessary to the recovery of coarse-grained mineral, but for the very fine or colloidal mineral, a small and comparatively brittle bubble is necessary.

Power. The National Copper Co., using approximately 950 cubic feet of air at 4-lb. pressure, and treating 500 tons per day on 8 roughers and 2 cleaners, required 35 hp.; this equals 3.5 hp. per cell, or 12.53 tons per horse-power, or 1.25 kw.-hours per ton.

Another company using approximately 9600 cubic feet of air at 5-lb. pressure and treating 2400 tons per day on 48 roughers and 12 cleaners, requires 210 hp.; this

equals 3.5 hp. per cell, or 11.45 tons per horse-power, or 1.56 kw.-hours per ton.

The Inspiration experimental plant, using approximately 950 cu. ft. of air at 5-lb. pressure and treating 200 tons per day with 4 roughers and 1 half-size cleaner required 24 hp.; deducting 4 hp. for two 2-in. centrifugal pumps, this equals 20 hp., or 4 hp. per cell, or 10 tons per horse-power, or 1.79 kw.-hours per ton.

A maximum figure would be 2½ kw.-hours per ton of feed, using 5 to 5½-lb. air-pressure, generated by a Roots or Connersville positive blower.

Summarized, my estimate on a 2000-ton plant will stand approximately as follows, in cents per ton of feed:

Labor	1.25
Oil	2.50
Maintenance	0.50
Power	2.50
Total	6.75

On a plant of 250 tons the extra labor would bring it up to approximately 10c. per ton. Actual figures from a large plant of over 2000 tons gave 6.1c. per ton. The

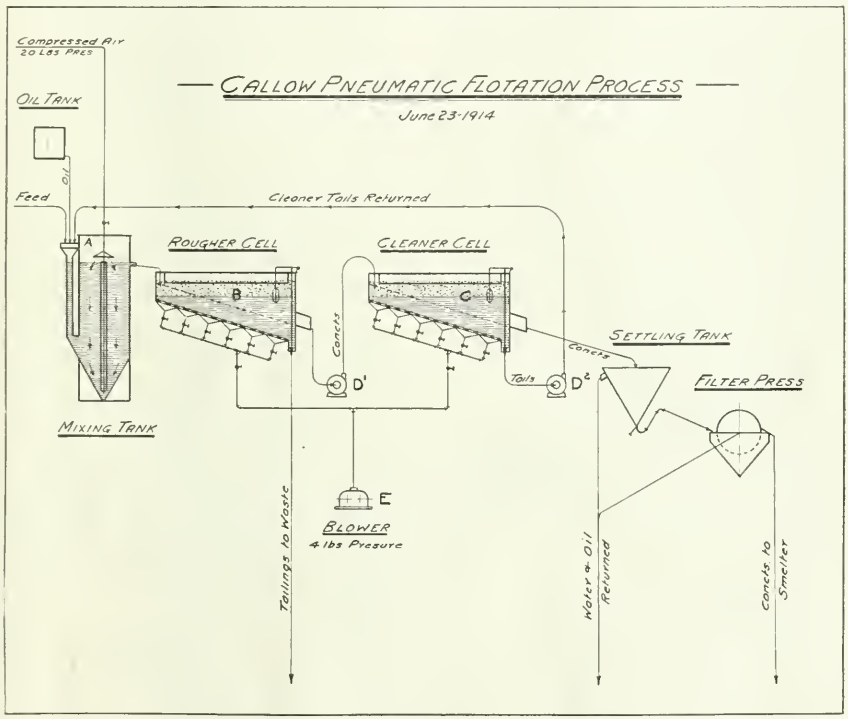


Fig. 5.

Cost. The oil-mixtures generally in use will cost from 1.25c. up to 3c. per lb. depending on the proportion of cresol and other high-priced oils used, but 1½c. per lb. will be a safe average on most ores. A consumption of 1 to 1½ lb. per ton or from 1.25c. to 4.5c. per ton of feed, say 2½c., would be a safe average. The labor, of course, will vary with the size of the plant. At one plant consisting of 60 cells, two men per shift operate the entire plant, equivalent to a cost of 1½c. per ton. One man per shift on a 250-ton plant will mean a cost of 5.4c. per ton in maintenance. Assuming a life of three months per blanket and 50 tons per cell and an allowance for repairs to blowers, motors, pumps, etc., we have ½c. per ton as a liberal estimate.

Power at 1c. per kw.-hour ($60 per hp.-year) and 2½ kw.-hours per ton equals 2.5c. per ton of feed.

flotation feed in this case represents 60% of the crude-ore tonnage or 3.5c. per ton of crude ore treated.

Theories. So far no satisfactory explanation of flotation phenomena has been advanced. At my instigation and under my direction, a large amount of research work has been done in an earnest endeavor to formulate some logical explanation, and perhaps to find some scientific way of conducting experiments in lieu of the empirical methods now in vogue. While this purpose has not yet been fully attained, the experiments have resulted in the formulation of a theory that appears to be well grounded and that may prove of value to others engaged in this branch of metallurgy.

Much work has been done at the Mellon Institute at Pittsburg under the direction of Raymond C. Bacon, and lately by James A. Block at the local station of the U. S.

Bureau of Mines. The results of some of this work are summarized in the following statements:

In considering the connection between flotation phenomena and the physical properties of the minerals concerned, there are two parallelisms to be noticed:

First: It has been noticed for some time that the minerals which floated were not easily wetted by water, while those which were easily wetted did not tend to come up with the froth. This is the basis of about the only theory that has been widely circulated up to this time. It is well stated by Hoover in his book, 'Concentrating Ores by Flotation,' the first authoritative publication on the subject.

Second: There is a parallelism between certain electro-static characteristics and the flotation properties of ores, as will be explained later.

In the theory first mentioned, it may be demonstrated by a consideration of surface tensions and contact angles that certain floatable minerals, such as galena, will float on the surface of still water, while gangue particles, on the other hand, possess a greater adhesive attraction for the water than the water's cohesive attraction for itself, and are therefore drawn through the surface film into the interior, where they sink because of their greater specific gravity. These properties of floatable minerals and gangues are increased by the presence of oil and acid. Oil sticks to galena with greater tenacity than it sticks to silica, and an oil surface is still less easily wetted than a galena surface. The acid in the water causes a still greater difference in the various surface tensions. This, it seems, is without question the explanation of such flotation as is obtained by the MacQuisten process, in which the ore particles are lifted to the surface and those remaining are removed by skimming the surface layer of the liquid.

As regards the second parallelism mentioned, it has been noticed that extremely small amounts of certain colloidal impurities, such as saponine or tannine, were detrimental to flotation, while others, such as Congo red and methyline blue, did not interfere, and were, if anything, beneficial. In classifying these, the injurious ones generally came under the head of what physical chemists call electro-negative colloids, while electro-positive colloids were not harmful. This classification is derived from the fact that suspended particles will generally migrate when placed in an electric field, and the classification comes naturally from the direction of their migration. This migration is called electro-phoresis, or electrical endosmose, and is the result of the fact that the liquid containing the particles forms contact-layers around them, similar to the surface-films formed when liquids come in contact with air. These contact-films almost invariably have a difference of potential between their inner and outer surfaces. The film of an air-water contact has, for instance, a difference of 0.055 volts[1], and other contact-films have similar charges. This causes the particles to act like charged solids, and to be attracted by electric charges of opposite sign.

[1]*Philosophical Magazine*, 1914, 27:297 and 28:367.

The charges on solids and non-miscible liquids can be conveniently studied on the stage of a microscope.

This work led naturally to the study of the charges exhibited by various ores and minerals, and in that work an interesting parallelism was observed; namely, that floatable minerals seemed to have positive charges and non-floatable gangues negative charges.[2] Some gangues were found with positive charges, but they were characteristically hard to handle, having a tendency to come up with the froth. These charges sometimes vary with the acidity or alkalinity of the liquid, and, this variation is not inconsistent with the effects of acidity or alkalinity on the flotation of ores.

It has been noticed that these electro-static properties depend on the condition of the surface of the particle and not upon the composition of the mass. For instance, lead oxide, which is ordinarily negative or neutral, when covered with a sulphide coating takes upon itself a positive charge.

Although these charges are small, recent work on the coagulation and deflocculation of slime, on the coagulation and dispersion of colloids, and along similar lines, show that these contact-film charges have an important bearing on the dispersion or coherence of particles suspended in liquid mediums. In fine suspensions and in colloidal solutions, these charges may often be neutralized by the introduction of oppositely-charged ions, and precipitation will generally take place whenever these charges fall below certain limits. Oppositely-charged contact-films have a general tendency to absorb each other, and to coalesce, while similarly-charged films, if their charges are great enough to overcome natural cohesiveness, do not seem to coalesce, but to repel each other, and if the weight of the particles is small enough in relation to their size and surface, permanent dispersion will take place, the particles distributing themselves through a liquid in much the same manner that a gas will fill a container.

In view of the above observations, it seems possible that flotation is due to differences in polarity in the charges on the various particles of ore, and on the bubbles. Since oil contact-films and air contact-films have both been proved to have negative charges, the positively-charged minerals might adhere to either. The bubble-mantles in a flotation machine are undoubtedly composed of oil, or of oil in emulsion, since pure water alone will not froth. The same forces, then, that cause oppositely-charged colloids to agglomerate and precipitate, cause the minerals to adhere to the oil-covered bubbles; and the same forces that keep the particles of an oil emulsion dispersed, keep the gangue-particles repelled from the bubbles.

Expressed briefly, the theory is as follows: That oil flotation is an electro-static process. It is a scientific fact that when a solid particle is suspended in water, the water will form around the particle a contact-film that generally possesses an electric charge, the amount and

[2]Kolloid Chemische Beihefte, 2:84; Zeit. für Physikalische Chemie, 89:91, 1914.

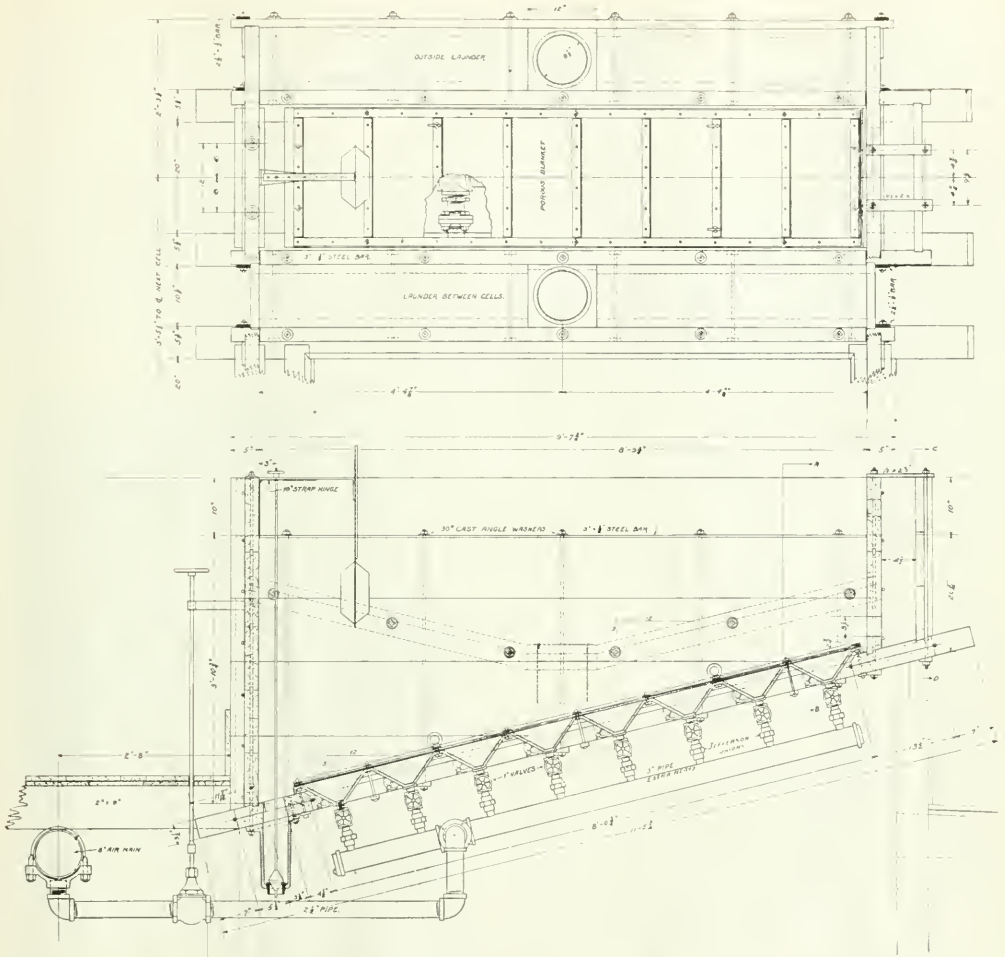


FIG. 6. PLAN AND SECTION OF THE CALLOW FLOTATION MACHINE.

polarity of which will depend upon the nature of the surface of the particle and the electrolyte in which it is suspended. The presence of these charges can be demonstrated by the fact that the particles possessing them will migrate when placed in an electric field. It has been demonstrated that floatable particles have charges of one polarity (positive), and that non-floatable particles have charges of the opposite polarity (negative), and that the froth is charged negatively and so attracts the positively-charged or floatable minerals, and repels the negatively-charged or non-floatable ones. It is this, it is believed, that causes the floatable minerals, such as galena or sphalerite, to adhere to the froth and rise, while the gangue-minerals, such as silica and limestone, remain in the liquid where they can be discharged as tailing.

A HUGE BLAST, breaking 75,000 tons of rock, was made at the H. Frazier limestone quarry, Fort Spring, West Virginia, in September. Fifteen holes were used, each 6 inches in diameter and all but two were 125 ft. deep; they were spaced about 15 ft. apart with a burden at the bottom of from 20 to 35 ft. In each hole was charged 400 to 500 lb. of 60% Du Pont gelatine on top of which was put 150 to 600 lb. of quarry-powder. On top of the charge was placed 20 to 30 ft. of clay stemming, while in ten of the holes the charge was separated near the centre by 10 to 25 ft. of clay. The charges were fired electrically by the superintendent F. R. Anderson. About half the stone was broken to one-man size and none was thrown over 100 yd. from the face. A total of 60,500 loose cubic yards or 75,000 tons was broken, an average of 5½ tons per pound of explosive.

Diamond-Drilling

By P. B. McDONALD

In much the same manner as the introduction of the machine-drill has benefited rock excavation by rendering it quicker and easier, the diamond-drill has expedited mining exploration. Diamond-drilling offers a convenient, speedy, even if only approximate, method of ascertaining the nature of a large extent or volume of rock. It is particularly helpful in obtaining prompt results at depths that sinking or tunneling would much delay, or in making a preliminary test over a wide area. Thus, during the Porcupine boom, the Dome Mines Syndicate wished to know at once whether its big hump of gold-bearing quartz possessed any continuity or was merely a surface blow-out. So, in addition to sinking three 50-ft. shafts and driving several hundred feet of drifts, it pointed some diamond-drill holes at an angle into the surrounding swamp to intercept the supposed orebody in depth. Had the cores obtained been barren of gold, it would have been a severe check to the exploration, but as the borings tended to confirm the evidence gained in sinking and driving, the promoters were prompted to go ahead with the elaborate developments of a mine and mill.

To a considerable extent diamond-drilling is useful in conjunction with sinking and driving. Thus an exploratory shaft may be deepened, and in its bottom several horizontal holes pointed off at various angles around a circle, to intersect possible orebodies. Or in a long drift underground, the old custom of exploratory cross-cuts may be supplanted by horizontal diamond-drill holes on both sides at intervals of, say, 100 ft. for the tapping of parallel orebodies or veins either in the foot-wall or hanging wall. These bores serve the exploratory purpose nearly as well as cross-cuts, and cost perhaps a half or a third as much per foot.

In the Lake Superior region, both in the Copper Country and on the Iron Ranges, diamond-drill exploration has been particularly developed. The utility of the diamond-drilling is suggested at once by the geological structure of the two districts. In the Copper Country the Keweenaw series, which contains the copper-bearing beds, is composed of a multitudinous succession of igneous flows intercalated between conglomerates, marking periods when the sea encroached on the land. These igneous and sedimentary beds are parallel to each other, and dip at from 30 to 70 degrees northwest, eventually flattening out under Lake Superior. The copper lodes, consisting of such occasional amygdaloids or conglomerates as have been mineralized, form only a small and irregular proportion of the whole. Thus, extensive diamond-drilling at approximately right angles to the dip of the formation, so as to cut the maximum number of beds, has become popular for preliminary exploration in depth, especially since the obviously rich lodes have been exploited. Operators in that region remember the interest taken in diamond-drill exploration several years ago when Lake, Indiana, Old Colony, Mayflower, etc., were being boomed on reports of diamond-drill cores. Thomas F. Cole has been employing the diamond-drill freely in the explorations of the Keweenaw Copper Co. where a large area of land was to be tested; and the Naumkeag Copper Co. and White Pine Extension did more or less drilling in their ventures farther south.

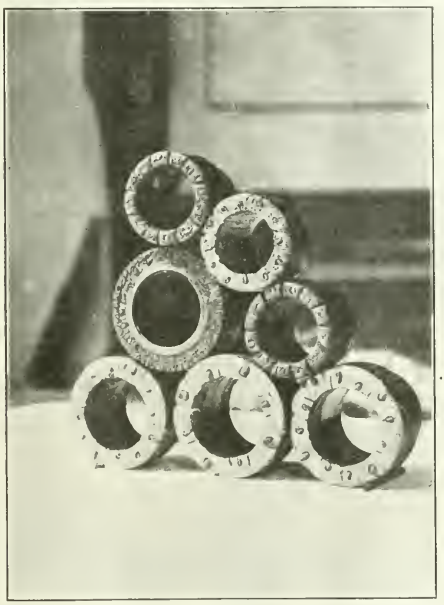
There has been even more diamond-drilling on the Iron Ranges than in the Copper Country. As soon as the ore deposits having outcrops were located, diamond-drills and churn-drills were employed in hunting for orebodies at depth. A great number of the iron-ore deposits occur as concentrations deep down in folds of the underlying slate, or caught on more or less impervious dikes, where the leaching of water during geological ages has stored up irregular masses of ore in all sorts of shapes and positions. Drilling campaigns of considerable expense have been undertaken by sinking holes to two or three thousand feet through slate or jasper in the hope of hitting an iron concentration in a deep fold at the bottom of the formation. Angle-holes of every variety have been pointed in and around the complicated structural features of the Iron Ranges, in search of the extremely various orebodies. When a drill-hole has once cut an appreciable thickness of iron ore, say a hundred or two hundred feet, it is usually attempted to determine the shape and size of the mass by more holes. In many cases the tonnage of ore is thus estimated correctly to the nearest million tons before a shaft is sunk or any plant erected. Some companies, however, after having drilled enough holes to indicate a reasonably large orebody, do not try to delineate its entirety, but put down one or two more holes to find a portion of the surface not underlain by ore to serve for the mine-buildings, and leave the ultimate extent of the deposit to be determined later by driving and sinking.

The immediate results of diamond-drilling are core and sludge. From drilling a 1000-ft. hole in rock each five feet of drilling may give an average of one foot of core, making 200 ft. of core obtained to judge the formations that have been penetrated. The other four feet of core becomes pulverized and washes up the hole as sludge, to be caught and dried in a special settling-box. It is fortunate when a full five feet of core is obtained for each five feet of drilling, as may be done in hard and homogeneous rock. An inspection and assay of such a complete core is wholly satisfactory and descriptive of the formations traversed. Where only a fractional part of the core is obtained, it is necessary to consider the

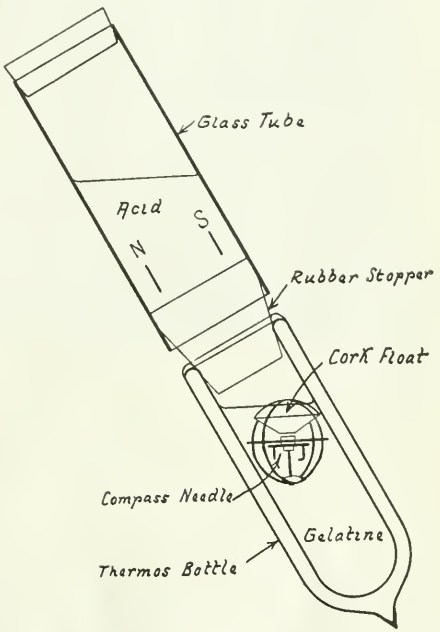
sludge carefully, as the core itself naturally represents the harder portion, which is likely to be lean and poor. In drilling through a hundred feet of an oxidized ore like hematite, if only one-fifth of the core be obtained in the core-barrel, the assays of the sludge should be given much more weight than those from the core; because, as can be computed by knowing the size of the drill and core, the core obtained represents only an insignificant part of the boring returns. The exact ratio for averaging core and sludge assays for each five-foot section of drilling can be figured exactly by measuring the bit, computing the relative volumes of core and sludges that should be recovered, and making out a convenient reference-table good for all lengths of core obtained. Special care should be taken when drilling to catch all the sludge.

The cost of diamond-drilling varies widely. It is generally more than $1 per foot (which might be the cost in a homogeneous soft shale or schist) and is usually less than $5 per foot (which figure is not unusual for broken hard jasper.) On one job of several thousand feet of drilling near Negaunee, Michigan, where working conditions were fair, four contractors bid $4 per foot, $3.25, $3, and $2.50. In this instance the work was in a swamp where water was convenient, but roads had to be improvised for short distances; the rock was silicious slate and hematite. The cost of the diamonds in the bits may represent from 10% of the total cost of drilling to 50%; black diamonds are worth nearly $100 per carat, and wear constantly in the drilling. The other items of cost are labor and fuel. A company on the Iron Ranges may spend $25,000 to $50,000 on diamond-drilling an orebody before sinking a shaft. It is in such large-scale operations that the diamond-drill is most advantageous. For shallow and small high-grade orebodies, the operator is likely to get more knowledge and satisfaction from sinking, driving, or cross-cutting, by which he can inspect results underground in place.

Strange occurrences sometimes complicate diamond-drill operations. Drilling into hard strata at an angle may bend the rods enough to turn the line of the hole into a big curve and cases have been reported of the bit even emerging to surface again, perhaps several hundred feet away. Test-bottles of dilute hydrofluoric acid are used to determine the dip of the hole at any desired point. I remember how one young engineer lowered a bottle of full-strength acid, only to pull up and find that the bottle had been eaten away by the acid, leaving only the neck. In careful or deep drilling where accuracy is important, surveying of the holes is worth many times its cost. This can be accomplished by a drill-hole compass, of which George Maas, of Negaunee, Michigan, holds the patents and which has been perfected by E. E. White of Ishpeming. The compass floats in liquid gelatine, which solidifies in the containing thermos-bottle or glass tube. The Cleveland-Cliffs Iron Co. has made over a thousand such tests in the last five years. Vugs or caves, sometimes of surprising size, exist in certain rocks and districts, requiring cementing or plugging in one way or another, before it is possible to proceed and properly recover the sludge-water. One drill-crew dumped several tons of oats, manure, cement, etc., into a



DIAMOND-DRILL BITS SHOWING DIAMONDS SET FOR BORING.



FLOATING COMPASS FOR SURVEYING DIAMOND-DRILL HOLES.

drill-hole before effecting a stoppage. Reaming of holes and lining with pipe is necessary in broken formations to effect a return of the water. Losses of the bit in the hole are not uncommon, necessitating tedious 'fishing' with the long line of rods to recover it. Separate diamonds may fall out, or a careless dropping of the rods may shatter the half-dozen diamonds in the bit, worth probably several thousand dollars. A drill-runner who drops the rods usually clears out for a new district without hesitation.

On the Iron Ranges a great deal of attention is devoted to the proper interpretation of diamond-drilling results. Special care is taken in recovering all the sludge in a large wooden settling-box; sludge and core assays are made for each five feet of ore-formation cut, and then carefully averaged in proportion to the amount of core recovered. Maps showing the holes are kept up to date, as well as such information on neighboring holes by other operators as can be obtained, and sections of drill-holes and their results are conveniently tabulated on tracing-cloth for making blue-prints.

The Study of Mining Geology

In a lecture to the students of mining at the University of California, John A. Burgess had, in part, the following to say concerning the 'Study of Mining Geology':

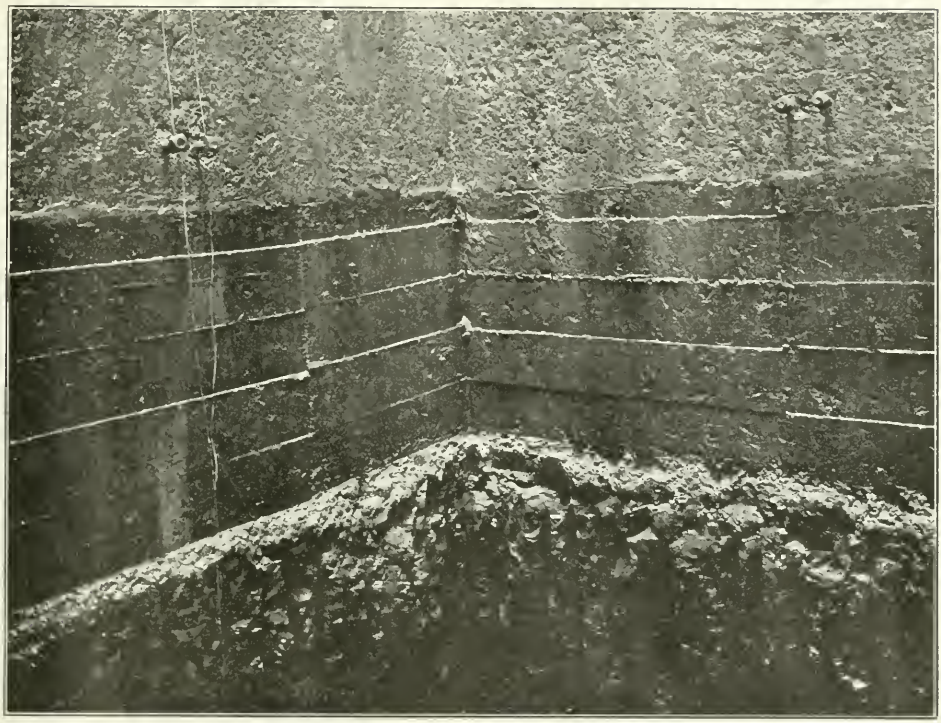
A man who has an absorbing interest in some particular line of work, who bends every effort to learn all there is to be known about it and to make himself proficient, will seldom fail to find an opportunity to exercise his knowledge; his pecuniary reward and the extent to which he becomes known in his profession will depend largely upon his business ability and his personality. If you are determined to be a first-class mining geologist no one can keep you from it. Your interest in the subject, your determination to pay the price in study, application, and perseverance, and your willingness to be known as a sort of a crank on geology are what will tell the tale; and when you do become proficient you will show poor business ability if you do not find employment in your chosen work. If the picture I have drawn seems a dark one, remember that I am making it so to give encouragement to the one who may have to travel such a difficult path. Usually the way is much more direct.

The new graduate in his first position is an apprentice. He should endeavor to arrange to serve his apprenticeship where it will have the greatest bearing on his chosen work; but there is no work, which, if it is done well and with interest, will not be of benefit in the way of experience. You will be surprised to see how things you have learned to do, apparently having no connection with your present work, come into play at unexpected times. My work as a boy, spraying trees in an orchard made me familiar with the Vermorel spray-nozzle, which is now used in connection with continuous filters, and through my knowledge of it I believe it was first applied to this class of machinery in our mill at Wonder, Nevada. Farm work, carpenter work, mechanical work, bookkeeping, anything whatever that you have learned to do well, is apt to be of service in your work as a mining engineer. The more experience you have had outside of strictly mining lines, the better engineer you will be. Concentration of effort on your specialty is, of course, essential; but, especially in one's younger days, it is not always possible to secure just the kind of employment one would choose. Valuable experience may be had, however, at any kind of work, and it would be a waste of experience, the worst kind of a waste, to feel contempt for any class of labor and fail to get what benefit may be secured from it. Make your breadth of experience, where it is forced on you, compensate for the temporary failure to acquire the special experience for which you are seeking.

In studying ore-formations, note dips and strikes of all faults and strata; take specimens of all rocks and map the veins with particular care. You can only map what you see, but be sure that you see all there is to see. Make all notes so clear that they can be understood readily by another geologist; unless you adopt this practice you will find yourself puzzling over your own notes in later years.

Ore often lies in shoots that have an unpleasant habit of coming to an end unexpectedly, either laterally or in depth, while on the other hand many an apparently worked-out mine has been re-opened with profit. In many veins the ore shows a preference for the hanging wall, the foot-wall being practically barren; this is sometimes caused by the vein being a compound one, having been deposited at two distinct periods; in this connection detailed study of drifts and old stopes may give evidence. Features to be noted are the degree of oxidation, whether the minerals are primary or secondary, their relation to the water-level and to the country-rock.

Mountains are classified by James Park in his 'Text-Book of Geology' as (1) Folded mountains, including all the great mountain chains of the globe that are known to consist of uplifted crustal folds; these are sometimes known as Alpine. The Sierras are of this type. (2) Volcanic mountains, hills, or ridges piled up by the accumulation of lavas and other material ejected from a volcanic vent or fissure, such as Mt. Shasta. (3) Plateau-mountains, are due to lesser folding than (1) and are subdivided into (*a*) Uinta structure, as in the Uinta mountains of Utah, which consists of two monoclinal flexures bending in opposite directions with a broad plateau between them. (*b*) Park Plateau structure, found in the Yellowstone Park, where Mesozoic rocks have been bent over a plateau-like complex of granites and gneisses and then denuded so that their truncated ends stand up at high angles against the central mass. (*c*) The Kaibab structure is a modification of (*a*). (4) Block-mountains have been formed by the displacement of large blocks as in Colorado. 'Horsts' are blocks that have remained elevated while the surrounding area has sunk. Residual mountains are left when the surrounding country has been eroded.



A TYPICAL CONCRETE SAND-SHAFT SEALED TO BEDROCK.

Grouting in a Shaft

By J. R. REIGART

*The Francis shaft of the Cleveland-Cliffs Iron Co. was sunk through quicksand to bedrock, a distance of 102 ft., by the Foundation Company of New York, which completed the work in June 1910. A concrete seal was put in the bottom and the shaft turned over to the mining company.

The shaft through the sand is circular, 17 ft. diam. inside, constructed so that it might be continued at standard size, 10 ft. 10 in. by 14 ft. 10 in. inside measurements, rectangular, with two skip-compartments, a cage-compartment, and a ladder and pipe-way. Work was resumed in the spring of 1911, but continued only long enough to put in the steel dividings, and to drill a number of holes through the seal to ascertain the flow of water to be handled. The holes all struck water in two or three feet, at a pressure of 40 lb., so that any two holes gave a No. 9 Cameron pump all it could handle. As fast as the holes were drilled, wooden plugs were driven into them. At first any handy pieces of wood were used as plugs, but these did not stop the water. Accordingly regular soft-pine plugs, from 3 to 3½ ft. long and tapering from 4 to 6 in. were made in the shops. With these the holes could be made water-tight.

These holes demonstrated the fact that a large flow of water would be encountered as soon as the seal was broken, and also that the slate probably was broken to a considerable degree. It was readily seen that the water would have to be stopped before continuing, or the shaft could be sunk only with the greatest difficulty and expense, if at all. The Foundation Company might have continued the shaft by its caisson process except for the fact that at the time bedrock was struck the men were working under 47-lb. air-pressure on 15-minute shifts. This was not only exceedingly expensive, but hazardous.

The rock at the bottom of the shaft being irregular, the thickness of the seal varied, but it was supposed to average 24 inches. The finding of water so quickly

*Abstract of paper presented at the Lake Superior Mining Institute in 1915.

seemed to indicate that the seal inserted by the Foundation Company had not formed a good contact with the rock. At this point work was discontinued and was not resumed until February 1, 1915.

When work was begun various means were discussed for permanently stopping the water, and it was decided to drill inclined holes around the inside of the shaft, at such an angle that they would reach beyond the outside circumference of the wall of the shaft; neat cement would be forced into these holes under air-pressure until all the water-bearing cracks and crevices were filled, making water-tight ground through which the shaft could be sunk with safety. It was feared that there was an open space between the seal and the rock covering a portion of the area of the shaft. If this were the case, the pressure exerted on the cement to force it into the holes would be transmitted against the bottom of the concrete seal and develop an enormous pressure. Thus there would be danger of breaking through it, which would be a serious matter. As a precaution 3-in. planks were set on edge 8 in. apart, like joists in a floor; on top of these and at right angles to them 12-in. square timbers were put across the shaft 4 ft. apart and spragged with stulls to the steel sets above. Wherever there was any space between the joints and the seal, wedges were driven so that, should there be tendency for the concrete to yield, the pressure would be instantly transmitted to the bracing. This covered the bottom of the shaft but left space for drilling holes until the space below the seal had been filled and the reinforcing could be removed with safety.

A platform was built 6 ft. above the bottom of the shaft; on this were placed the air-pressure grout-machine, the valves for operating the low and high-pressure air-line, and a No. 9 Cameron pump. On the set above, two other pumps were installed, a No. 8 Cameron and an Alberger electric pump. This gave a pumping capacity of from 1400 to 1600 gal. per minute. A 3-in. pipe-line for conveying the grout, which was to be mixed on surface, was hung so that it emptied directly into the grout-pan. The tank used was the Caniff machine. It consists essentially of an iron tank 24 by 48 in. with connections for admitting air at both the top and bottom. When the tank has been charged, air is blown in at the bottom to agitate, thus insuring a thorough mixture and preventing the grout from setting. This air is then shut off and air admitted at the top to eject the grout. The hose between the tank and the grout-pipe was 2 in. in diameter, and of extra quality rubber warranted to stand a pressure of 300 pounds.

The grout pipes were made from 1½-in. standard pipe 3 to 4 ft. long. To the end to be driven into the hole, a bell made from a piece of 2-in. pipe 8 ft. long was welded. The 1½-in. pipe is pushed into the large end of the bell until its end is even with the unexpanded end of the bell, the pipe being welded at this point. A unit of operations was the drilling and grouting of 6 holes spaced at equal intervals around the circumference of the shaft, numbered in the order drilled. To drill these 6 holes and put in the grout-pipes was a day's work for a crew of two men and a foreman. On the following day these holes were grouted, and for the next two, work was suspended to give the grout time to set and harden. At first only one day was allowed for this, but it proved insufficient where a large amount had been put into one hole. A total of 41 holes was drilled and 27 were grouted. As the work progressed the holes were drilled deeper, until 14-ft. holes at an angle of 45° encountered no water. Finally a few holes, No. 38, 39, 40, and 41, were drilled in the interior of the shaft to reach any seam that might run parallel with the inclined holes, and which these holes might have missed. As no water was encountered, all was now ready for sinking.

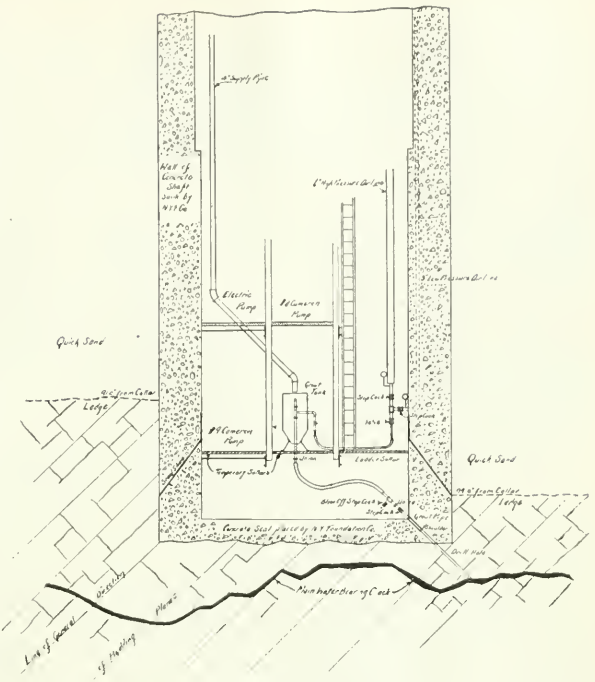
Grouting was started on the morning of March 26. A gauge attached to one of the grout-pipes showed a pressure of 43 lb. It was surmised that there were large areas to be filled, so that the only pressure to be overcome would be the hydrostatic head. Therefore 60 lb. was used in the first operations. The mixture was thin, being composed of two 12-quart pails of cement and four 12-quart pails of water. Consequently the grouting went so slowly that the mixture was changed to one bag of cement and three 12-quart pails of water to a batch. It is important that the mixture be thin enough so that it is perfectly fluid. No sand was used in these mixtures, but it may be, if desired. The cement was screened over a heavy wire screen running 4 meshes per inch, to take out lumps. The first hole grouted was one drilled in the operations of 1911. Some of the plugs put in at that time were not tight enough to keep the thin mixture of grout from being forced back into the shaft. Wherever possible, these old plugs were replaced by regular plugs, but there were some that could not be removed and that could not be made tight enough to withstand the grout. Accordingly bran was forced into the hole, and then a richer mixture made with one bag of cement per batch. The hole soon filled and there was no more trouble from this source.

From the first holes, in particular, the water brought up fine sand and small pieces of broken rock. With the first of these, the water was stopped as soon as the grout-pipe had been made tight, but later the stopcock was left open and the water allowed to flow for a period of 10 minutes until the water became clean and free of sand. The effect of this was seen later when the bottom of the shaft was removed; in holes that had not been allowed to clear themselves the grout was mixed with the sand in the seams and could be readily taken from the cracks with a pick, but wherever the holes had been allowed to clear themselves the cracks were filled with hard clean cement. Hole No. 113 required 332 bags of cement. After two days' work with 60 lb. of air, it was decided that the seal and bracing were strong enough to stand a pressure of 80 lb., and this pressure was used thereafter. Some holes that would not take grout at 80 lb. were given a pressure of 150 lb. This pressure was used also toward the completion of the holes when they began to take grout slowly at 80 lb. When the holes were taking grout freely we operated at the rate of a batch of grout every 50 seconds, which was as fast as the cement could be screened, mixed and sent

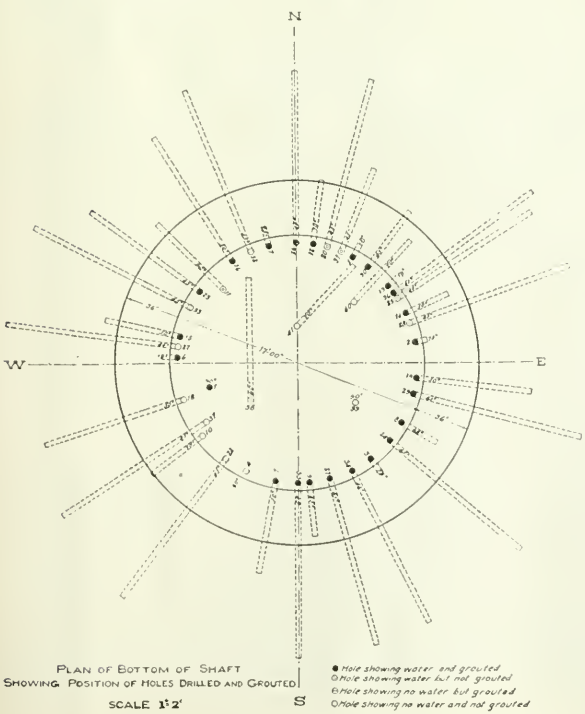
from surface. The crew on surface consisted of five men, one man bringing the cement from the store-house, one man screening, one measuring the charges, and two mixing and stirring with paddles to insure a thorough mixture. In the shaft the foreman operated the grout-machine, one man the blow-off valve near the grout-pipe, and one the stopcock on the grout-pipe.

Where the openings to be filled are as large as they were in this case, an 80-lb. pressure will suffice, but where the seams are smaller, higher pressure is not only desirable but necessary to overcome, in addition to the hydrostatic head, the friction in the seams. The farther the grout can be forced, the more effectively will the water be stopped. If high pressure could have been used from the beginning, this particular job could have been finished with fewer holes. The grouting was completed on April 26, a month after starting.

When it had been demonstrated that the water had been stopped, the rectangular shaft was started. Holes 8 ft. deep were drilled around the perimeter of the rectangle 2 ft. back from the line of the shaft and as close together as possible. The first 4 ft. was then broken by mailing and with wedges and feathers. The concrete seal was the hardest part of this work as the rock broke easily along the slips and joints. For the next cut the holes were drilled on the outside of the shaft as before and the ground broken by drilling and blasting with light charges of powder, not over a half-stick per hole, and never over two or three holes at a time. This was repeated until the shaft was 18 ft. below the shoe of the concrete sunk by the Foundation Company.



CROSS-SECTION OF SHAFT SHOWING CRACKS IN THE ROCK FILLED BY GROUTING.



PLAN OF BOTTOM OF SHAFT
SHOWING POSITION OF HOLES DRILLED AND GROUTED
SCALE 1:2'

● Hole showing water and grouted
○ Hole showing water but not grouted
⊖ Hole showing no water but grouted
○ Hole showing no water and not grouted

To secure further the portion of the shaft that had been grouted, the sides of the shaft traversed by the filled seams were lined with a reinforced-concrete wall averaging two feet thick. Hitches were cut 12 ft. below the shoe and 9-in. I-beams put in for bearers along the small dimension of the shaft. To these bearers, hanging-bolts were attached. Forms were then constructed along the line of the shaft from the top of the concrete seal to 2 ft. below the bearers. First, however, $1\frac{3}{4}$-in. cramp-rods, spaced 2 ft. apart, were put in the walls of the shaft. Wire rope, pieces of expanded metal, iron bars, pieces of old angle-iron and channels were fixed for reinforcing. The space was then filled with concrete having a composition of one part of cement, one part of sand and gravel, and two parts of broken rock. This was given two days in which to set and then work was resumed.

When the bottom of the shaft was removed, the

conditions were not as had been anticipated, as the seal had a good contact with the rock over the entire area of the bottom of the shaft. What we did find was a large seam varying from 2 to 6 inches wide cutting across the entire shaft within a few inches of the bottom of the seal.

The cost of the work up to August, when two shifts could be employed and sinking proceed in the usual way, was as follows:

Grouting	$1,431.74
Sinking	1,882.45
Timbering	885.15
Concreting	407.42
Total	$4,606.76

When the advantages gained are taken into consideration, the method seems inexpensive. To pump the flow of water, if it had not been stopped, is problematical, but 4000 to 5000 gal. per min. is probably a low estimate. If the shaft could have been sunk to the present depth by ordinary methods, and the water could have been caught and pumped, the expense of installing the necessary equipment and of pumping such an amount of water over the period of years comprising the life of the mine would be enormous. It is obvious that a company could afford, if necessary, to spend several times the above amount to get the result obtained. The method of grouting water-bearing seams can be used at any depth provided sufficient air-pressure is available. For effective results, the air-pressure should be from 100 to 200 lb. over the hydrostatic head. No further trouble from water is anticipated in the sinking of the Francis shaft, as a diamond-drill hole was found at a depth of 865 ft. in the bottom of the shaft and no water was coming from it.

Arizona and Modern Mining

By L. D. RICKETTS

*Most of you know my State—its glorious hills and deserts in the south, its forests and soul-inspiring canyons and summits in the north. One is impressed by its bigness and intensity and grandeur; but one must be impressed also with its vast actual and potential resources as a copper producing state.

Some years ago a wave of agitation swept the country over the conservation of our natural resources. The subject was not properly understood and there was much apprehension. Many advocated self-denial of the present generation in behalf of succeeding generations. Assertions were made that our mineral resources had but a short road to exhaustion and were being used up with reckless waste to the danger of civilization. Like all awakenings, the situation did good, but the chaff had to be winnowed out of the wheat, and of chaff there was a great abundance. The first fact that developed was the broad one that future generations would have the advantage of accumulated knowledge and would be in a better position to care for themselves, and that the present generation is, therefore, entitled to take from the earth that which it needs, provided always that such action is accompanied with a minimum waste and destruction. The second fact that developed was that while the richest deposits of our mineral wealth were being exhausted, the arts of mining and metallurgy were so rapidly advancing that leaner and hitherto unprofitable ore deposits were being brought to the point of profitable exploitation and by this means the actual quantity of the metals available in profitable ores instead of decreasing was increasing manifold.

This has been the work of the engineer aided by capital. But to accomplish his result the engineer has had to supplement individual effort with organization and committee work and to recognize that the field has become too large for any one man.

The great requisite was the power to recognize latent possibilities; the recognition of the importance of vast tonnages of mineralized rock, even if the metal-content be very low, together with the courage and earnestness to recommend the vast expenditures that modern mining and metallurgical problems now require, with a full sense of responsibility and to patiently wait all commercial results from the investment.

The second requisite was to recognize the limitation of the individual and the necessity of the association of a great variety of talent exercised by a large number of men into a working organization of ability, courage, and spirit. The whole question of the economical generation and application of power to mining and metallurgy had to be studied, mining methods had to be revolutionized in order that the efficiency of labor might be greatly increased and metallurgical methods had to be enlarged and vastly improved, in order that the ultimate percentage of recovery of the metal might be greatly increased and the unit costs of reduction tremendously decreased. And we have also had to study new processes and the means of utilizing by-products that have heretofore gone to waste.

The work in Arizona has been the result of the single efforts of no individual. Several splendid organizations have worked in parallel in the State, each guided wisely and ably by a united staff. And it is through this that my State has become the greatest copper-producing district in the world. It is through the united efforts and association of engineers, of capital, and of labor that Arizona copper mines and reduction works have sprung from that which a few years ago were but great masses of uncommercial copper-bearing rock, and some millions of tons of copper have been made available to the arts.

*Abstract of address at the Panama-Pacific Exposition, November 18, by "the Most Distinguished citizen of Arizona."

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

WALLACE, IDAHO

MEETING OF THE A. I. M. E. IN THE COEUR D'ALENE.

The fifth annual meeting of the Columbia section (formerly the Spokane section) of the American Institute of Mining Engineers was held at Wallace, on November 19 and 20. A party of about 30 members and visitors went from Spokane on the first day, and these were met at Wallace by others from various parts of Idaho; the total attendance at the meetings, including local members and others connected with mining, was about 100 persons.

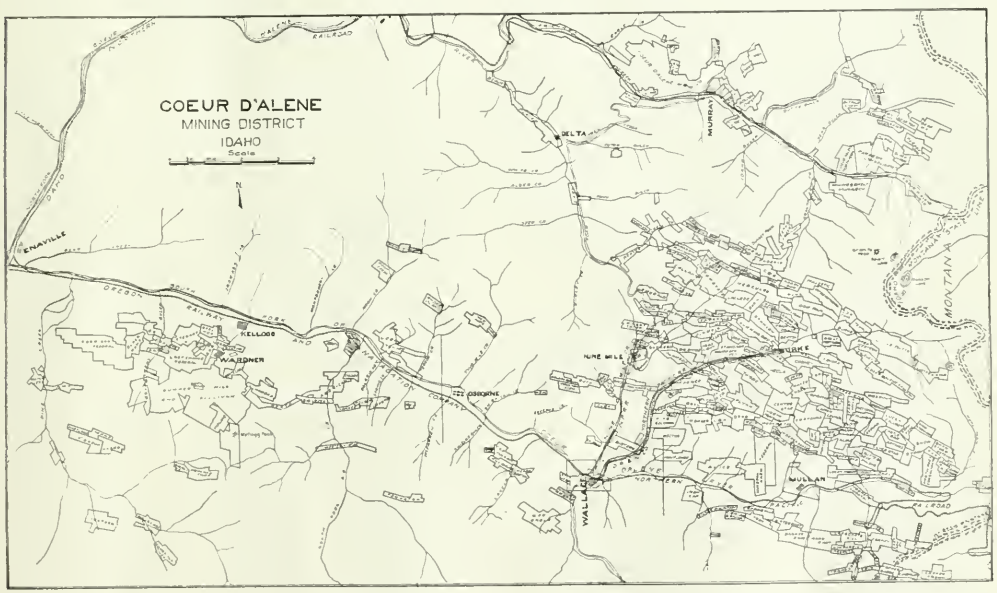
As a suit involving the question of extra-lateral rights was being heard in the local Court, the proposed afternoon session of the Institute was not held, most of the members attending the Court session instead to hear the expert evidence given. In the evening the meeting was presided over by Stanly A. Easton, of Kellogg, general manager of the Bunker Hill & Sullivan company, who on behalf of the Shoshone county members extended a hearty welcome to the visitors. The secretary, L. K. Armstrong, of Spokane, read a lengthy communication from the chairman of the section, Frank A. Ross, of Spokane, who had been prevented by illness from attending the meeting. Four papers were presented as follows:

(1) 'Progress in Ore-Dressing,' by D. Wilson Buckby, mill superintendent for the Stewart Mining Co., who dealt with recent developments in mill practice in the Coeur d'Alene district, the paper being an excellent presentation of a subject of general interest. In the course of the discussion that followed, flotation oils had attention, and in this connection M. G. Donk, of the Bureau of Chemistry, Washington, D. C., who is engaged in investigating the subject, asked for the co-operation of local mill-men in obtaining information relative to the possible production of pine oil from western woods, and data concerning the consumption of flotation oils in the district.

(2) 'Mine Accounting for Small Mines,' by J. E. Chapman, of the Federal Mining & Smelting Company.

(3) 'Zinc Smelting and Smelter Rates,' by W. E. Henry, of Spokane, district representative of the Empire Zinc Company.

(4) 'Leaching Zinc Ores,' by D. C. Livingston and W. M. Ellis, this being notes, illustrated by diagrams, on leaching tests made by students at the University of Idaho, Moscow.



The second day was occupied in visiting mines and concentrating-mills in the neighborhood of Wallace, including the zinc mine and mill of the Consolidated Interstate-Callahan Mining Co., the mills of the Success and Marsh companies, and a trip underground at the Bunker Hill & Sullivan Co.'s mine at Kellogg.

In the evening a business session was held, at which the result of the ballot for officers for the ensuing year was announced, as follows: chairman of the section, Stanly A. Easton; vice-chairman, Frederic Keffer, Spokane, Washington; secretary-treasurer, L. K. Armstrong, Spokane (re-elected). A banquet, provided by the local members, followed, and at this the vice-chairman, Rush J. White, gave place to Mr. Easton as chairman for the evening. Those who accepted the chairman's invitation to speak after the banquet were E. Jacobs, of Victoria, B. C., secretary of the Western Branch of the Canadian Mining Institute; Glenville A. Collins, chairman of the Puget Sound (Washington) section of the A. I. M. E.;

R. N. Bell, inspector of mines for Idaho; and J. M. Porter, one of the pioneer mining engineers of the Coeur d'Alene district.

After Mr. Armstrong had made announcements of particular interest to members, this most successful meeting of the Columbia section was closed, with thanks to local members and others for their hospitality and kindness.

TORONTO, ONTARIO

Cobalt, Porcupine, and Kirkland Lake Developments.—Consolidated Mining & Smelting Co. of Canada.

There is increased activity at Cobalt owing to the advance in the price of silver, and several companies which had curtailed operations are increasing their forces. Shipments of bullion are light, and there has been a disposition to limit the output sufficient to cover working expenses; but most of the companies are putting a good deal of energy into development work and the improvement of underground conditions.

Some important new discoveries are announced: The Kerr Lake company in trenching at the old Drummond mine has discovered a niccolite and smaltite vein 8 in. wide, assaying about 400 oz. silver per ton, and overlaid in places with shoots of plate-silver.——At the Mercer, formerly the Gould, operated under lease from the Peterson Lake company, a 2-in vein of high-grade ore has been cut in a raise from the 200-ft. level. ——The Chambers-Ferland is extracting rich ore from a vein found in a winze at the 400-ft. level, and is exploring territory adjoining the Nipissing vein systems.——The president of the Nipissing, E. P. Earle, states that the vein recently discovered in the Cobalt Lake fault is the most important development made by the company in the past two years. It is apparently 8 to 10 in. wide, and is worth from 1800 to 2000 oz. per ton.———At the Adanac a winze is being sunk from the 200-ft. level on a vein which is widening at depth, and shows niccolite, cobalt, and native silver.——A vein has been cut on the Shamrock, adjoining the Beaver, reported to assay 1500 oz. per ton.——The Temiskaming, which will shortly increase its mill capacity by 30 stamps, has declared a 3% interim dividend.——The English head office of the Mining Corporation of Canada has ordered the discharge of all alien enemies employed at the Cobalt Lake, Cobalt Townsite, and City of Cobalt mines. About 50 men, nearly all Austrians, have accordingly been dismissed.

At Porcupine, the Hollinger is opening the area to be served by the new central shaft under Hollinger hill. Three separate orebodies have been found in a cross-cut at the 425-ft. level. These are respectively 10, 6, and 4 ft. wide, and will assay $10 per ton. The shoot near the Millerton is improving in grade at depth. A contract for the head-frame over the central shaft has been let. The hoist to be installed here is of 5000-ton capacity, raising 5-ton skips.——At the Dome, the new five-compartment shaft is down over 50 ft. Good progress is being made in opening the seventh level, where there is now a considerable quantity of ore available.——The Schumacher, which is now producing regularly, has cut a station at the 600-ft. level, and will open this and the 500-ft. levels simultaneously.——In drilling from No. 4 level at No. 5 shaft, at the McIntyre, a mineralized belt about 15 ft. wide has been cut on the 600-ft. level, with an enrichment in the centre about 3½ ft. wide, which gives high assays. The main shaft on the McIntyre Extension is down 850 ft. A good orebody has been opened on the 300 and 400-ft. levels. The milling capacity of the McIntyre will be increased by 50% in January, and the plant will then be in position to treat ore from the McIntyre Extension and the Jupiter.

The Tough-Oakes at Kirkland Lake, is now operating both mine and mill with electric power. Underground development has lately been attended with highly encouraging results, some rich ore being extracted from both vein systems.——The Montana & Hecla Mining Co. has purchased the McGuire claims in the Goodfish Lake part of the Kirkland Lake district, and will sample them by diamond drilling——The Dominion Reduction Co. has dropped its options on claims held at Goodfish.

The Consolidated Mining & Smelting Co. of Canada, has sent out a circular to its shareholders in connection with the issue of new shares giving a statement of the affairs of the company. There has been a considerable expansion of its productive capacity. The zinc output for 1916 has been contracted for by the Canadian Shell Committee, at the request of which the company has undertaken the refining of copper. This will be carried on to a limited extent for a while, but it is expected to develop and involve the treatment of much of the matte and blister copper produced in British Columbia. The output of refined copper during 1916 will be taken by the Committee at a fair price. When plans now being carried out are completed, the lead-producing capacity of the plant will be increased 60%, and put on a more economical basis. The demand for lead during the past year has taxed the capacity of the furnace to the utmost, and the output has been sold for six months ahead.

LONDON

Munitions and Labor.—Dredging in Russia and Colombia.—Mining in Russia.—Burma Corporation Prospects.

Manufacture of munitions is now going forward at a comfortable rate, and we have time to think a bit of other things. Really surprising work is being done by the munition plants, and when the whole story comes to be told, there will be much more to be said for what was accomplished than of the 'muddling' of which for the last few weeks we have heard so much. Women have taken the place of the men with remarkable results, though *Punch* does represent a mistress as warning a maid who gives notice preparatory to taking a job in a munition plant, by saying: " You know, Mary, that if you go around there dropping shells as you have been dropping plates, you won't stay in the situation long." That is a libel. While so many maids have gone that there is even danger of the "knocker on the big front door" going unpolished some morning, the effect in the factories has been excellent. It is the universal report of the manufacturers that the output per operator has increased enormously, and that it has proved possible to put women not only on the unskilled but much of the skilled work, therefore releasing men to go to the front. I even heard last night of a salesman for an electric-goods house who proposed to enlist and let his wife handle his trade while he was gone. All this is not only helpful now, but extremely suggestive as to that dark future after the War, of which there are so many forebodings. It is already recognized that when the men come back, many of them will not stay here, but will go to the colonies. If it prove possible so to re-organize industry as to use better those who do remain, and to use the surplus of woman's labor that always exists here, the country will be industrially stronger even if 'the master's boots' are not always well polished. However that is a problem for the future. It suffices now to note that we are forwarding plenty of munitions, and still able to take contracts for mining machinery, even if we cannot for the present compete as fiercely for business as before. I note that the chairman of Fraser & Chalmers, Ltd., reported to his stockholders that at the beginning of the War the company had felt obliged to decline contracts for certain dredges in prospect, for fear of disappointing buyers as to promised delivery. In general, however, our machinery men find it possible to take care of all regular customers.

Dredging. Speaking of dredges reminds me that in the Kytlim Valley, Russia, where dredges are used to recover both gold and platinum, results continue to be good. R. S. Botsford described for readers of the Press, in February last, the character of the enterprise. There are now three boats at

work, one a Putiloff of 5½ cu. ft., another a Marion 7½ cu. ft., and the third a second-hand Putiloff that has been digging without much success in another part of the estate. I understand that Mr. Botsford has no responsibility for the last-named result. The Marion boat is reported to be moving nearly 5000 cu. yd. per day, at a cost of 62c. per yd., with a recovery of about $2.85 per yard. The Putiloff boat is treating 120 to 150 cu. sagenes—1700 to 2000 cu. yd. per day. As the estate is large and the results are good, it is not unlikely that more boats will be built. In contrast it may be noted that the returns from the Nechi (in Colombia) have not come up to expectations, though there may be good reasons. The first figures issued, covering two weeks ended on November 1, showed that 77,322 cu. yd. dredged has yielded $16,715, equivalent to 21.3c. per cu. yd. The estimate for 90 acres of tested ground, it will be remembered, was 70c. per cu. yd. And it will also be remembered that at the meeting of the company in August the chairman stated that it was expected that the dredge would begin operations September 1. He then estimated that the return for the last two weeks in September would be £10,000. No one experienced in dredging will consider it a serious matter that on a two-weeks run the yield is below the average determined by drilling, any more than he would be especially elated and re-calculate the value of his shares if for such a period the returns were more. It is also to be remembered that it was necessary for the dredge to move across the river from where it had been erected, and to dig a pond in lean ground. An office note added to the report is to the effect that the dredge is still working in ground of medium value, and that it will be a couple of months before it has worked its way through to the rich ground. Incidentally, it may be noted that Nechi is one of the companies that will need to take careful account of the new 'war profit tax,' since all of its income for this year will be excess over that of the year before—it being a new company—and so will be subject to a 50% tax unless the proposed revenue measure be modified. On the whole, and regardless of the value of the ground and the excellence of the dredge and the technical direction, Nechi does not seem likely to pay large profits immediately.

Russian Mines. The Anglo-Russian mining companies are doing well, and there is great activity at all points. Moderate dividends, of course, are the order of the day, for exchange is heavily against bringing money out of the country, and only limited gold shipments are permitted. The Kyshtim even found it advisable to cease export of its rich precipitate and to build a small refinery. R. Gilman Brown, who recently returned from Russia, reports things moving rapidly at the Irtysh and elsewhere. The new zinc smelter, of 480 retorts, will begin to produce about the first of the year, and a whole railroad, rolling-stock, and all, was bought from the Russian government and moved to the mines. The Government is helping the mining companies in every way possible, as the importance of a supply of metals is fully realized. At the Spassky and Atbasar active building of smelter and other works is under way and at the former good production is kept up. E. T. McCarthy was not able, as Mr. Brown was, to buy a complete railroad—I do not know if there were competitive bids—but he did buy a long train, several locomotives, and about 13 miles of track. With this he is moving the new machinery across the steppes by alternately tearing up the rails behind the train and re-laying them in front. The new railroad and port that Russia has built on Kara bay ought to make it possible by spring at least to bring in adequate supplies. The line is actually laid, but not yet ballasted, and those who rode from Chitina to Kennecott (in Alaska) the first season the Copper River line was open, will realize what that means as regards heavy shipments of machinery, for the country is about the same character. In connection with the Copper River line, we learn with interest that the equipment is to be considerably augmented to carry the Kennecott copper ore.

Company Reports. You will have had the Tomboy report and noted the continued success of that excellent property. Purchase of the White Cloud is looked upon here as an excellent stroke of business. The Messina report shows good profits and increased recovery, but a considerable shrinkage of ore reserves. A thorough examination by A. F. Kuehn has been made, and his figures have been adopted by A. B. Emery, who is now manager. The Burma Corporation, by way of contrast, shows a great increase in reserves, and T. J. Hoover estimates that if the great ore-shoot continues another 50 ft., which will bring it to the Tiger adit-level, some 3,000,000 tons of ore will be available. At present the reserve stands at 2,000,000 tons, containing 27% lead, 22.5% zinc, and 25 oz. silver per ton. It will be nine months or a year before the mine and the adit are connected, and for the present more interest attaches to the 250,000 tons of high-grade lead (45%) silver (44 oz.) which is to form the immediate source of income. It is expected that the production will be sufficient to not only pay operating expense but provide all the capital needed for the next year. The Burma board has recently been re-constituted so as to bring to it certain gentlemen formerly connected with railways and Government work in India. The relations of the Corporation to local officials have not been altogether happy, and it is hoped in this way to decrease friction. As an example of how matters have gone, it may be stated that local officials asked about $12.50 per hp.-year bare rental for water-power. At this price it was cheaper to buy Sulzer-Diesel engines in Switzerland and generate electricity from oil, which has been done, though the water-power is thereby wasted. It is unfortunate that in India, as in some other quarters of the earth, the indirect benefits to a community of the development of a large enterprise seem not to be recognized fully. However, the world is hungry for metal, and mining engineers are pre-eminently able to accommodate their work to conditions as they actually exist.

CRIPPLE CREEK, COLORADO

Shaft-Sinking and Treatment-Plants.

The past three weeks have been extremely quiet as far as rich discoveries are concerned. The larger mines have produced the usual quantity of ore. It is considered that November will be the banner month of the district.

Sinking is now in progress at the main shaft of the Elkton Con. company. If the water continues to recede at the present rate a new station will be cut before many months.

The shaft of the Golden Cycle company will be sunk another 25 ft., and then a station will be cut. After this a 50-ft. sump will be excavated. When this is accomplished the total depth will be 2225 feet. This will make the Golden Cycle the deepest in the district.

A new hoisting plant with capacity for hauling from a depth of 2000 ft. has been ordered for the Dillon mine on Battle mountain. In all probability the Dillon shaft will later become the main shaft of the Granite company.

The mill owned by the Isabella Mines Co. has been leased to John C. Klauck for five years. It is understood a straight cyanide process will be used. Both mine and dump rock will be treated. It is hoped to have the mill running at full capacity early in the new year.

After careful experiments conducted over a long time, the Portland company has decided that the low-grade ores of the Cripple Creek district can be successfully treated by oil flotation. The Independence mill at Victor will soon be equipped with machinery for this process.

At a recent meeting of the shareholders of the Dante company it was decided by unanimous vote to extend the charter for another period of 20 years.

The Colburn mill at the Ajax mine is treating 60 to 70 tons of ore daily; this will soon be doubled. Forty sets of lessees are busy in this mine.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

FAIRBANKS

A company has been organized at Fairbanks to mine coal from the Nenana coalfields as soon as the Government railroad is completed, which may take two years. As firewood costs $16 per cord, equivalent to $32 per ton for coal, only rich quartz mines can be worked; but with coal landed at $5 to $6 per ton, many low-grade claims can be developed, as has been discussed in the PRESS by our Fairbanks correspondents.

THE NEW RAILROAD AT ANCHORAGE, ALASKA.

About $50,000 will bring the coal area to the production point, as the seams are exposed.

A steam-shovel, to be driven either by steam, electricity, or gasoline, is to be tried underground in a gravel mine on Fairbanks creek by J. W. Toole and others.

Some of the antimony ore being mined at Fairbanks has been sent to the Chapman Smelting Co., San Francisco, with which the miners are satisfied. A shipment in September amounted to 78 tons of ore, from the Ridgetop and Eagle mines. It averaged respectively 55 to 61% metal, for which the high price of $2.20 for 55% and $2.50 for 60% ore per unit was paid. The total gross amount of the shipment, which was paid for on a spot cash basis, after being received at the smelter, was $10,871.

ARIZONA

COCHISE COUNTY

The 1915 Mining Review issue of *The Bisbee Daily Review* was published on November 21. Besides covering the Warren and other districts of this county, the whole of Arizona is discussed by various writers, summarizing as follows:

"Mining in the entire state of Arizona was never in a healthier condition than it is today. From every district comes the report of progress and development, not mentioning the production of the proved mines. The prospector is being heard from in every part and money is to be had for the development of properties. The manner in which the general public is responding to the demand for money in the Mohave County goldfields is ample proof that one of the greatest mining booms, in the history of the United States, is about to be seen. By the laws of the State of Arizona there can be little or no wildcatting. In this way the investor in the mines that are now being promoted will get at least a run for his money. There has always been the complaint that the promoters got all of the money, and little of it went into the ground. The charge has been justified in a number of cases. At the present time, however, the corporation commission is very closely scrutinizing the application to sell stock, and the margin of promotion costs has been cut to a minimum, assuring that the money subscribed or a great proportion of it, will be expended for legitimate purposes."

GILA COUNTY

Work done on the 22 claims of the Powers Gulch Development Co. along the Gila and Pinal counties boundary, totals nearly 2000 ft., down to 176 ft. depth, and the lessee, U. Jackson, has opened good tungsten ore. A shipment of 831 lb. sold to the Primos Chemical Co. realized at the rate of $1346 per ton. This ore was not dressed. The property also contains good copper ore.

Another blast-furnace, No. 3, was blown-in at the Old Dominion smelter on November 20. The mill is treating 700 tons daily. No. 18 level has been drained, and the electric pumps are at work.

At the Inspiration there has been a general clean-up of the debris on the surface and underground. The miners' change-house is nearly ready. The coarse-crushing plant is complete. Nine units are working in the mill.

A power-plant to cost $50,000 is contemplated by the Arizona Commercial company at Globe. The monthly output is 400,000 lb. copper, yielding a profit of $20,000.

GREENLEE COUNTY

The Federal government investigation into the strike at Clifton is now under way. It is reported that strike-breakers are being brought into the district, and trouble is expected.

MOHAVE COUNTY

At 900 ft. in the Gold Road mine, a large orebody has been opened on the foot-wall. The last weekly shipment of bullion was worth $19,000.

The Copper Giant mine, eight miles east of Hackberry, is sending 40 tons of rich ore daily to the United Verde smelter at Clarkdale; this will shortly be increased to 100 tons. Development at 500 ft. has been most satisfactory. W. Neagle is in charge.

The Iowa claims have been sold to E. M. Coplen and H. A. Cole of Los Angeles for $150,000. The mine is opening in splendid style. F. W. Dryden of the Boundary Cone company was connected with the transaction.

A large deposit of disseminated copper ore is said to have been proved at Mineral Park, in the Cerbat range, Wallapai district; O. A. Turner is interested.

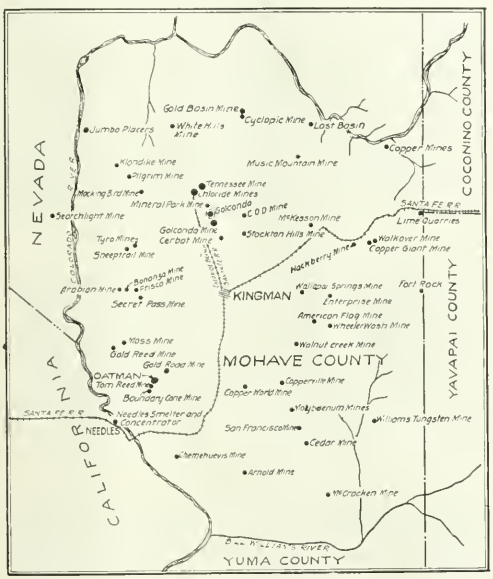
At 505 ft. in the United Western a station and sump have been cut.

Sinking to about 500 ft. is under way at the Lexington-Arizona, Nellie, Lucky Boy, Lazy Boy, Oatman Southern, Goldroad Capote, Lost Treasure, and United Southern mines.

In the Cedar Valley district, 56 miles south-east of Kingman, the Arizona Venture Corporation is to enlarge its operations. The ores contain zinc, gold, and silver. In the Waldron claims lenzite crystals, used in wireless telegraphy, are found. A recent shipment contained 405 crystals, valued at from $4 to $25 each.

The Putney claims have been bought by J. Parke Channing, G. W. Long, and J. L. McIver.

The Oatman district was recently inspected by J. K. Turner of Goldfield, Nevada, and he made the following remarks in part: "I am very much impressed with my observations in the camps of Mohave county, which I have visited during the last few days. This region is the cynosure of all eyes of the mining world, and I consider its future as particularly bright. The activity at Oatman is truly astounding, as is also the extensive programs of operations outlined by no less than 30 companies, which appear to be well financed and prepared for deep work. The United Eastern is a remarkable property, and I have no doubt that others similar to it will be developed in the district. * * * One of the notable features of the present activity throughout Mohave county is the presence of such a large number of former Goldfield people. * * * In addition to Oatman, I have visited the Maynard district and inspected the property of the Arizona Tellurium Mines Co., which, I found, has a wonderful showing for the amount of development accomplished. The formation there is granite, intruded with porphyry dikes. * * * I have also visited the Stockton Hill portion of the Cerbat range, but made only superficial inspection of several properties. The conditions prevailing there are pleasing. I have been commissioned to examine several properties in this section for prospective buyers and upon my return here in a few weeks, will make a more complete study of conditions throughout Mohave county."



MAP SHOWING MINES IN MOHAVE COUNTY, ARIZONA.

The Ajo railroad will be finished to Ajo wells early in January. Rails have been laid to Black Gap, 18 miles south of Gila. The country between Gila and Ajo is practically a desert. The water supply for Ajo has been developed in an extensive 'wash,' seven miles north of the New Cornelia mine of the Calumet & Arizona company, from where it is to be pumped through a 10-in. pipe. Exploration is still under way at this great property. A 40-ton leaching-plant is producing some copper from the experiments under way. A 3% sulphuric acid dissolves the copper, which is afterwards electrically precipitated. Employees at Ajo are mostly Mexicans; the population is 1000.

Pima County

Yavapai County

The United Verde Extension mine is producing 40 tons of ore per day, employing 80 men. Results on No. 14 level are very satisfactory.

(Special Correspondence.)—The Sunflower Cinnabar Mining Co. has made an unexpected discovery of quicksilver ore in the Packover claim. This mine is situated in the Mazatzal range, about 75 miles north-east of Phoenix.

The Randolph-Gemmill Development Co. at Crown King is reported to be treating successfully the refractory ores of that district, and is milling 100 tons daily of the Crown King dump, on which a lease is held. The company will enlarge the plant to treat custom ore.

Hübnerite has been found by some Prescott people in the Eureka district, on claims adjoining the holdings of Lawler, Wood, and Conner, who have already made shipments of this ore.

Prescott, November 27.

ARKANSAS

Benton County

The Arkansas zinc and lead region was recently visited by J. P. Dunlop of the U. S. Geological Survey. He was impressed with its possibilities, and estimates an increase of 400% in output over last year. Prospecting and mining are done at low cost on account of the hilly nature of the ground. Most of the mines are dry.

From the Red Cloud mine near Rush, an important development is reported at 1100 ft. in an adit.

CALIFORNIA

Amador County

The South Eureka company has resumed mining at its Oneida property, nearby. Unwatering is to be commenced, and then the opening of the known orebodies. W. J. Bryant is in charge under W. H. Schmal, the superintendent of the company.

The Rhetta mine, four miles north of Plymouth, is to be re-opened by B. C. Clark, who will install machinery at once.

Renewed activity is reported from the old Charleston district.

Inyo County

The Wilshire Bishop Creek mine is closed again until the spring; only a watchman remains. Results were fairly satisfactory. Mining was done above the 300-ft. level. Up to October 1 the output for the season was 5000 tons valued at $11.40 per ton. Recovery is not as good as desired, and the cyanide-plant may be converted into one using flotation.

Nevada County

Owing to caving there has been a good deal of trouble in unwatering the Union mine at Nevada City, under bond to San Francisco people.

Plumas County

A stamp-mill has been erected at the New York mine, owned partly by Mrs. J. F. Peattie of Chico, Butte county. A large quantity of ore is ready. More machinery will be added in the spring.

San Bernardino County

(Special Correspondence.)—All parts of the Atolia district are busy. The main interest is development of new veins and pockets, along the Piute, Paradox, Papoose, and Churchill veins, which is being pushed with vigor by the Atolia company. The management is preparing for an increased production, and contemplates employing at least 150 additional men. To cope with this extra force 85 additional 10 by 12-ft. tents, with board floors and walls, are being built at the north side of the mill. The place is now a large tent city. Additional tools and steel have been ordered, and there is every indication that machine-drills will be used on the lower levels.

On the 150-ft. level of the Papoose, near its east end, a lessee named Harry Hughes, has high-grade ore. Seventeen men are working two shifts.

At Churchill No. 1, the main shaft is down over 1000 ft., with good ore at the bottom.

On the Spanish lease a new hoist and head-frame are being erected, with ore-bins, engine-house, and blacksmith-shop. The orebody continues good, and is apparently the same vein that has been cut over 1000 ft. east in the Lipp and Brock lease, on the Skylark claim. This lease has been a great producer of scheelite of exceptional value. A carload of concentrate was shipped East last week valued at $60,000. Besides this, 13 tons was purchased by the Atolia company at a high price, said to be over $40 per unit of 60% grade.

Carl Mangel, who picked up 650 lb. of float in a drift at the bottom of his shaft, recently found the vein from which it came. It is said to be a large low-grade lode with alternate streaks of rich ore.

New and promising tungsten developments are reported 2½ miles south of Atolia on the old Kramer road. Stringers of quartz containing a fair percentage of tungsten have been found near the surface in granite. It has been termed 'the orange-pickers find.'

Miners are continually arriving here, and this part of San Bernardino and Kern counties appears attractive to lessees and prospectors, all of whom are apparently prosperous. Many outfits are moving about with automobiles especially equipped for camp life.

Traveling auto-stores that sell groceries, meat, fruit, and produce, have made their appearance, doing a thriving business. One of these last week brought the Los Angeles dailies of the same day to Atolia, beating the train deliveries by over four hours.

A tri-weekly auto-stage from Randsburg to Los Angeles, run by W. Eaton, carries passengers and fast freight between all points en route, *via* Atolia and Lancaster. The trip is made in seven hours, and when desired the route is varied by way of San Bernardino and Kramer, both coming and going.

A few investors are becoming interested, but the lucky ones generally seem content to work their own properties and sell the high grade at $1.50 to $2 per lb. to local buyers.

Atolia, November 25.

Shasta County

The Balaklala mine is shipping 9000 tons of ore per month to the smelter at Kennett. One hundred and twenty men are employed.

Deeper work in the Greenhorn copper mine is very encouraging. Old workings have been connected. M. E. Dittmar is manager.

Siskiyou County

On account of the snow in the Salmon River district most of the miners are closing for the winter; these include such producers as the Black Bear, Cub Bear, Highland, Homestake, and Trail Creek.

Stanislaus County

A narrow-gauge line is being surveyed from Patterson to the magnesite mines, a distance of 22 miles.

Trinity County

Work has been resumed at the old Mammoth claims on Bullychoop mountain, near Douglas City, by D. C. Dedrick. Some good ore is ready for the small battery on the property.

On November 25 two inches of rain fell at Weaverville, and 30 in. of snow at the Globe mine near Dedrick, also 24 in. of snow on the divide between French Gulch and Deadwood.

Tuolumne County

(Special Correspondence.)—The Black Warrior mine, situated on the east belt, is one of the most promising properties to be re-opened in this vicinity in the past year. The property is being developed by an adit, which is in 300 ft. The vein is large and the ore free milling. A two-stamp mill was recently erected and is operating at full capacity. The Black Warrior was located in 1856 and worked by the late E. Westinghouse.

The Experimental mine, in Experimental gulch, above the town of Columbia, is yielding good returns to its owners. Conlin Bros. A 2800-ft. adit has been driven to cut the ore-shoot that was very rich on the surface in the early days. The adit has some distance to go before this shoot is cut, but a rich orebody has been opened and is being milled. Three more stamps are being added to the original two, and the plant will be in operation within another week. For two months preceding the closing of the mill, the output was over $4000 per month.

Sonora, November 27.

COLORADO

Boulder County

During October the Chamberlain ore-sampler at Boulder handled over 600 tons of tungsten ore, compared with 248 tons of gold, silver, copper, and lead ore. The average value of tungsten ore exceeds $300 per ton, making $180,000, while the average value of the gold and silver ore was only $35 per ton, with less than half the quantity of tungsten ore, netting the producers only $8750. Thus it will be seen that there is over double the tonnage of tungsten ores marketed in Boulder over gold and silver, and that the miners receive about twenty-five times as much for tungsten ores as for the other minerals mined.

Clear Creek County

Chicago and St. Louis people, headed by L. W. Shaffer, have obtained control of the McClelland Tunnel Co. owned by the United Freeland Development & Tunnel Co. The sum of $150,000 changed hands, and $100,000 has been allotted for working capital. The area comprises 106 patented claims, mill-sites, and three tunnel-sites, with a total length of 18,000 ft. The McClelland tunnel is in 7149 ft., and will be extended 3000 feet. The Freeland mine has a production of $5,000,000 since 1869. A large mill is proposed.

Gilpin County

The Polar Star mill, at the mouth of Chase gulch, Black Hawk, has been secured by the Bates Leasing Co. The plant is being overhauled, Wilfley or Card tables to be installed, and probably a flotation-plant.

High-grade ore continues to come from the Pittsburg mine in lower Russell gulch; it returns up to 9 oz. gold, 9.4 oz. silver, and 17.6% copper.

Lake County (Leadville)

At the Penrose shaft of the Down Town area the water is down to 687 ft. Large quantities of water from old stopes tax the pumps to their limit. The heavy work of clearing and retimbering the 600-ft. station is finished.

Steady progress is reported from the Anderson adit near Birdseye.

The new leasing company at the Big Four mine on Breece hill has commenced work, with John Cortellini in charge. The lessees feel confident of good results.

San Juan County

A flotation-plant has been installed at the Gold King mill at Silverton, and treatment is in full swing in charge of Louis O. Bastian.

A 500-ft. contract has been completed at the Columbus mine at Animas Forks, and a similar distance is to be driven in the Elk company's mine, 3½ miles from Silverton.

Teller County (Cripple Creek)

At 1300 ft. in the Gold Sovereign mine the shoot has been opened 60 ft. The core is very rich, and is being sacked.

Recent assays at the north and south end, over 18 in. in each, gave 11.48 and 266.5 oz. per ton.

At the Jerry Johnson the Cripple Creek Deep Leasing Co. has opened 60 ft. of ore at 850 ft. depth. More men are to be employed.

The Cresson continues to produce rich ore, and during the past 30 days eight cars of ore were valued at $380,500.

At the Independence mill a large sampler is to be constructed, while plans are complete for the installation of a flotation-plant in place of the present cyanide-plant. Ball-mills will supplement the Chilean mills.

IDAHO

According to an estimate of the State mine inspector, Robert N. Bell, the mineral output of Idaho will be $30,000,000 in 1915, an increase of $5,000,000 over that of last year.

Clearwater County

The holdings of the Ozark Mining & Milling Co., consisting of the Wild Rose group of 14 claims and the Ozark group of 7 claims, three miles east of Pierce, abandoned for the last three years, have been located by R. H. Bailey, mining engineer, of Spokane. Mr. Bailey announced this week that development of the properties would be begun next spring, when a compressor and hoist will be installed. A lower adit was driven several years ago a distance of 1250 ft. in the Wild Rose area, and a raise opened good ore. Water stopped work in the Ozark but $10 to $15 ore was left in the face.

Shoshone County (Coeur d'Alene)

The Alameda *v.* Success apex-suit is attracting a good deal of interest at Wallace, but progress is slow. Maps and models are used by both sides.

A good shoot has been cut in the Surprise mine, nine miles from Kellogg. The new 150-ton mill is at work. The concentrates assay 40% zinc, 70% lead, and 20 oz. silver per ton. Motor-trucks haul the product to the railway at Kellogg.

The Federal Mining & Smelting Co. has declared $1 per share on the preference shares, equal to $120,000, making $480,000 for the year. Common shares have received nothing since January, 1909.

Development at the Sunset mine, on Sunset peak, has opened a good deal of zinc and lead ore. To allow of larger operations, a new hoist, compressor, drills, etc., motor driven, have been ordered.

The Hecla company at Burke has declared a dividend of 7c. per share, equal to $70,000; this makes $465,000 for the current year, and $3,655,000 to date.

The Colonial Mining & Milling Co., operating the Little Pittsburg on Pine creek, has secured a contract calling for one car daily after January 10, according to J. D. Beebe of Wallace, president and manager of the newly organized company. A 250-ton concentrator is being erected on the Colonial ground, one section being now in place. A tramway, 5178 ft. long, is also being constructed to convey ore from the mine to the mill, from 40 to 50 men being employed in order to rush the work. A sorting-plant is being erected for handling the high-grade ore. No. 2 adit has been started, and should cut the vein at a depth of 600 ft., in 450 ft. No. 1 adit cuts the vein 400 ft. below the surface, and at this point there is an ore-shoot 20 ft. wide, containing zinc, lead, and silver. After sorting out the rich ore, it should concentrate to 45% zinc.

MICHIGAN

The Copper Country

Copper shipped from Lake Superior mines this season by the Mutual Transport vessels will be 100,000,000 lb., fully 30,000,000 lb. above the total of last season. Two steamers were loading 3000 tons each last week.

Further diamond-drilling at the White Pine has proved the extension of the copper-bearing sandstone. It is said that a larger mill will be erected next year about four miles from the mine.

Good progress is reported from the White Pine Extension. A caterpillar tractor is hauling supplies, resulting in reduced cost.

MISSOURI

Jasper County

For over $100,000 the Knight Investment Co. of Utah secured the Lucky Tiger and Black Hawk mines at Neck City last week. They were owned by G. L. Cole, are good properties, and are equipped with a 250-ton mill each.

The output of the Missouri-Kansas-Oklahoma district during the week ended November 20 was as follows: blende, 6301 tons; calamine, 1179 tons; and lead, 884 tons, averaging $100.77, $66.11, and $62.63 per ton respectively. The total value was $770,368, and for 47 weeks, $22,018,220.

On account of the continued high prices of ores an increase of wages is expected in the district for December.

The Home Talent mine at Duenweg has produced calamine worth over $400,000, with plenty more ore ready. Calamine mines do not last long as a rule.

MONTANA

Cascade County

The Montana Power Co. has completed its Volta hydro-electric plant at Big Falls, 11 miles from Great Falls on the Missouri river. This work occupied three years. The plant includes four 15,000-hp., and two 800-hp. generators. Two more large units are to be installed. The power is used for mines, mills, and smelters, in Montana and Idaho, electric railways, and town lighting.

Silverbow County

The October output of the Butte & Superior mine was as follows:

Ore treated, tons	43,092
Zinc concentrate, tons	10,473
Extraction, per cent	93
Value of product per ton	$79.59

When the East Butte company's Pittsmont shaft was sunk to 1830 ft. from 1500 ft. a very wet and heavy fault was cut, hindering work. This is now better, and sinking will soon be resumed to 2100 ft. Ore is being mined between 600 and 1500 ft. The re-modeled smelter has a capacity of 900 tons of ore per day. Two units of the flotation-plant will be ready early in 1916.

NEVADA

Esmeralda County

The final report of the Goldfield Consolidated for October shows that the net profit was $98,376 from 36,500 tons of ore. Costs were $4.40 per ton. Development totaled 2760 ft. at $4.51 per foot. Lessees produced 119 dry tons of ore of a gross value of $3995, from which the company received $1998, less the cost of transportation and milling.

At a depth of 428 ft. the first coal seam has been cut in the new shaft of the Darms Coal Mining Co. at Coaldale. It is small, but of good quality.

Humboldt County

The Rochester Mines Co. contemplates additions to its mill, and has secured further water-rights in Relief and Buffalo canyons.

The new 100-ton mill of the Nevada Packard Mines Co. commenced work on December 1. It was constructed by K. Freitag. Six men is the only labor required.

The Nenzel Crown Point Mining Co. has resumed work; its property adjoins that of the Rochester Mines Co.

The first deep work at Willard which is to prove or otherwise that the veins persist to depth is about to be undertaken at the Kaiser lease on the Sheepherder's Dream. B. T. Godfrey of San Francisco has bought-in on the lease, and is to erect a hoist for the new work. The last discoveries in the group indicate that the old high-grade vein has been recovered, and it is asserted that there are several thousand dollars in sight at the present time.

LYON COUNTY

The Nevada-Douglas new leaching-plant will soon be working at full capacity. A large supply of ore is waiting at the mine, also custom ore. High-grade copper ore is being shipped to Utah, a contract for 1000 tons being arranged with the International Smelting Co. at Tooele.

MINERAL COUNTY

Claim-jumpers at 25 miles north-east of Mina were recently decided against by the Court at Hawthorne. They had jumped part of the ground of J. P. Nelson, but it was held by the Court that his monuments prevailed over the call in his notice, although his measurements were incorrect. Work is to be resumed on the property.

NYE COUNTY

Tonopah mines last week produced 9951 tons of ore worth $205,078. The rise in the price of silver has cheered up everybody. Satisfactory developments are reported from several mines. On January 2 the Belmont company will pay 12½c. per share.

STOREY COUNTY

Prospects at the Union Con. and Sierra Nevada mines at Virginia City are very encouraging. At 100 ft. in the joint raise from 2500 to 2400 ft. an east cross-cut has opened $50 ore.——The Mexican mill treated 168 tons of $25.63 custom ore. ——The United Comstock Pumping Association has repaired 302 ft. of the 2700-ft. level. The pumps at 2000, 2300, and 2500 ft. are working well.

TEXAS

CULBERSON COUNTY

(Special Correspondence.)—Mining in western Texas is busier than at any previous time, there being considerable preparation in opening mines and extracting ore.

The Mineral Milling Co. has been organized with a capital of $50,000 to operate in the Hazel district, near here. The incorporators are Henry M. Sutton, Walter L. Steele, and Edwin G. Steele.

The Culco Mining Co., which was recently organized with a capital of $5000 with its head office at Dallas, will start development in the Van Horn district. The incorporators are A. C. Horn, L. E. Dougherty, Jesse Williamson, and Daniel Byrnes, all of Dallas.

Van Horn, November 27.

UTAH

BEAVER COUNTY

A considerable amount of development continues at Fortuna. The Davis lease has crushed 30 tons of ore worth from $30 to $50 per ton. Properties are being taken under option.

The U. S. S. R. & M. Co. has purchased the Lumry and Moore claims for $150,000, 10% being paid down and the balance spread over 18 months. The company also took over the Davis lease.

BOXELDER COUNTY

Three miles north of Brigham, ore assaying up to 68% antimony, 25% sulphur, 2.9 oz. silver, and 0.3% arsenic has been opened. A sample weighing 110 lb. has been on view at Ogden.

JUAB COUNTY

Tintic mines shipped 139 cars of ore last week.

A lessee at the Chief Consolidated has opened high-grade gold ore.

On the 1000-ft. level of the Lower Mammoth, ore assaying 30 to 40 oz. silver and 4% copper has been cut. It is four feet wide. Zinc ore is being extracted from the 1400, 1500, and 1700-ft. levels.

A carload of ore from a new shoot in the Yankee Consolidated assayed about 180 oz. silver, $8 to $10 gold, and 5% lead.

From the 1600-ft. level of the Mammoth 2-oz. gold ore is being shipped. A large body of copper ore exists at 600 ft. The mine generally is in splendid condition. Earl McIntyre is superintendent.

On December 20 the Eagle & Blue Bell company will distribute 5c. per share, equal to $44,657, making $133,972 for 1915. The monthly output is 3000 tons of $30 ore. A new 250-hp. electric hoist is being made in the East.

SUMMIT COUNTY

Park City mines shipped 1516 tons of ore last week.

On December 21 the Silver King Consolidated will pay 10c. per share, or $63,750, making $252,500 for 1915.

WASHINGTON

FERRY COUNTY

(Special Correspondence.)—The Quilp Gold Mining Co. has brought suit in the Superior Court in and for Ferry county against the Republic Mines Corporation, to enforce the trustee in bankruptcy of the latter to deed the ground disputed in a former suit, which was compromised by contract of settlement on May 2, 1913. The hearing of the case was continued from November 18 to December 17, on account of illness of the trustee in bankruptcy.

Republic, November 19.

OKANOGAN COUNTY

(Special Correspondence.)—The manager of the Arlington mine, Ernest Stoolfire, will ship 50 carloads of ore this winter. Thirty men are employed on day and night shifts.

Marshall and Roe of Seattle, who bought tungsten claims near Cathedral peak, a short distance from the international boundary, have been developing the property, and now announce that they will build a wagon-road and erect a concentrating-plant. At present the mines are almost inaccessible. The concentrate is mostly wolframite, assaying as high as 73% tungstic acid.

In the Chesaw district the Molson Gold Mining Co. is applying for patent to the Peerless placer ground.——At the Gold Ax mine a night shift has been started, and from shaft-sinking, ore is being extracted and shipped to the smelter.——In the Enterprise mine an adit is in 120 ft., and connected with a shaft at a depth of 75 ft. A drift is being driven on the vein, to be continued to No. 2 shaft, several hundred feet distant. ——The Caribou mine is under active development and producing low-grade copper ore.——The Iron Mask is showing some fine copper ore.——Good gold-bearing ore is being developed in the Roebuck and North Star claims.

A company has been formed by a number of business men in the town of Twisp to develop placer ground five miles from the town, on which claims have been staked along the bottom of Twisp river. The gravel beds are thought to extend several miles along the river.

The Stewart Calvert Co. of Seattle, is shipping a large quantity of epsom-salts (magnesium sulphate) to New York, Philadelphia, Chicago, and Pittsburg, said to be 98% chemically pure, from a lake owned by the company near Oroville. Freight is $10 per ton to Chicago, and $15 per ton to New York, Philadelphia, and Pittsburg. The shipments are reported to average 250 tons per day from Oroville, over the Great Northern railway. The supply is said to be very large.

Republic, November 19.

STEVENS COUNTY

Northport, where the smelter is being re-built, is very busy, there being over 250 men employed. One large job is a three-mile flume and tunnel for hydro-electric power. The Day interests, connected with this smelter, have purchased the Pennsylvania Smelting Co.'s refinery at Carnegie, Pennsylvania, to receive products from Northport.

CANADA

MANITOBA

(Special Correspondence.)—Canada has another gold rush, and prospectors who have been locating claims in the Rice Lake district, 100 miles north of Winnipeg for the past year, have brought in samples which seem to indicate that the locality is rich in minerals. Claims are also being staked in the Gold Lake district, 50 miles north of Rice lake.

The strata extends from Cumberland lake, north-west of La Pas, south-easterly into the Rainy River district. There is a gneissic formation, with seams of from one to six inches wide, showing tracings of gold, iron, barite, with some copper and silver. La Pas is a town of about 3000 inhabitants, situated on about the only available crossing of the Saskatchewan river for 100 miles on either side. The town is on the south side of the river, the Indian reserve on the north. It is difficult to reach, as there are only three trains a week on the Canadian Northern to this point. Another means of reaching the Rice Lake district is by a small steamer from Winnipeg to the mouth of the Monogotogan river, which flows into Lake Winnipeg, 100 miles from Winnipeg; from there it is possible to ascend the river in canoes 50 miles to Ratroot lake, and then overland, and from there portaging over rough country, a distance of 12 miles to Rice lake, thus making the transportation of machinery extremely difficult, even that of a portable nature.

The Beaver Lake goldfield, which also is being developed in a small degree, but which is being thoroughly prospected, is north-west of La Pas. Practically all of the claims filed in the district have been staked for speculative purposes. Several prospectors and mining engineers from Boston and Minneapolis have gone to the new field, and on returning were reticent as to the prospects. The Provincial government is to make an effort to obtain the mineral rights from the Dominion government, which owns all the minerals in the Province of Manitoba. According to the records, Manitoba has received upward of $4000 in fees for recording the 746 claims in good standing in the Rice and Gold Lake districts. These records show that $260,000 has already been expended there, 20% of which has been for transportation.

Winnipeg, November 25.

YUKON

In the Mayo district a good deal of development is reported, and the next season is expected to be a good one for placer and quartz mining.

MEXICO

The National Railways of Mexico report as follows for the year ended June 30, 1915:

	1914.	1913.	1912.
Total operating revenue..	₱34,273,341	₱57,370,282	₱61,987,108
Net	3,454,363	21,299,478	21,888,033
Deficit after charges.....	28,835,624	687,383*	2,360,347*
Preferred dividends	.....	1,153,316	2,306,632
Deficit	28,835,624	465,933*	53,715*
Profit and loss deficit....	28,736,661	98,963*	567,052*

*Surplus.

SONORA

On November 23 the first train for several weeks left Naco for Cananea loaded with supplies of all kinds for people and mines. Not much damage has been done to the town. It is expected that mining and smelting will be resumed before long.

PERSONAL

S. A. IONIDES is here from Denver.

RICHARD A. PARKER has gone to Boston.

W. DEL. BENEDICT has returned to New York.

FRANK L. SIZER has gone to Tonopah, Nevada.

THOS. H. LEGGETT was at Los Angeles this week.

FRED T. GREENE, of Butte, is at the Hotel Oakland.

BEN. B. LAWRENCE is on his way back to New York.

ARTHUR W. JENKS has returned from British Columbia.

WILLIAM B. DENNIS, of Carlton, Oregon, is in San Francisco.

H. W. GEPP left San Francisco for New York on November 26.

E. E. PRICE, from Salt Lake City, is at Sonora, in Tuolumne county.

DAVID J. ARGALL passed through San Francisco on his return to San Diego.

ROBERT M. BETTS, manager for the Cornucopia Mines Co., of Oregon, is here.

HENNEN JENNINGS has been appointed a consulting engineer to the U. S. Bureau of Mines.

STANLY A. EASTON, manager of the Bunker Hill & Sullivan mine, Idaho, was here during the week.

W. J. LAKELAND, of the Burma Mines, Ltd., has arrived here from Burma on a journey of technical observation.

ALTON DICKERMAN, geologist to the Allouez copper mine, in Michigan, is taking a holiday in southern California.

L. D. RICKETTS, W. D. THORNTON, A. C. JAMES, T. M. SCHUMACHER, and WALTER DOUGLAS were recently at Globe, Arizona.

J. G. BERRYHILL, vice-president of the Nevada-Douglas Consolidated Copper Co., was at Ludwig last week inspecting the new plant.

P. D. BURTT has been examining properties at Manhattan, Nevada, and has returned to the Nevada Packard mine near Rochester.

L. C. DE LA MARLIÈRE, general manager for the Andrada Mines, Ltd., in Mozambique, has returned to France, to serve his country.

CORNELIUS CUDDIHY, smelter foreman for the Anaconda, is in the Copper Country of Michigan to visit the Calumet & Hecla smelters.

W. R. RUST has severed his long connection with the Tacoma smelter and resigned the presidency of the company controlling that A. S. & R. plant.

SUMNER S. SMITH, Federal mine inspector in Alaska, has been at Valdez with W. MALONEY, the Territorial inspector, visiting the Ellamar copper mines.

PIERRE BOUERY, for 15 years manager of the La Grange placer mine, Trinity county, has been appointed manager for the Valdez Creek Placer Mines in Alaska.

D. D. HOMER sailed on the *Newport* from San Francisco on October 23 for La Union, San Salvador, to serve as assistant manager at the Divisadero mine of Charles Butters & Co.

JAMES FORGIE, consulting engineer of New York, has been awarded the Telford gold medal by the Institution of Civil Engineers (Great Britain) in recognition of his paper on 'The Laxaxalpam Aqueduct Tunnels in Mexico,' and of the achievement in engineering that was the subject of the paper.

Obituary

ORVILLE A. DERBY, geologist to the Government of Brazil, committed suicide at Rio de Janeiro on November 27.

FREDERICK W. DODGE, president of the F. W. Dodge Co., publisher of the Dodge Report Service, Architectural Record, Record and Guide, Sweet's Catalogue, and others, died recently at his home at Manhattan, New York, at the age of 51. He was born at Melrose, Massachusetts.

THE METAL MARKET

METAL PRICES.

San Francisco, December 1.

	Cents per pound.
Antimony	40
Electrolytic copper	20.75
Pig lead	5.50— 5.70
Quicksilver (per flask)	$105
Spelter	21
Tin	43
Zinc-dust, 100-kg. zinc-lined cases	35

ORE PRICES

San Francisco, December 1.

Antimony: 50% product, per unit	$ 2
Chrome: 52% chromic oxide and 2% silica per ton	12
Magnesite: plastic, free from iron and lime, calcined, per ton	55
Magnesite: refractory, up to 5% iron, calcined, per ton	30-35
Manganese, 50% metal, 8% silica, per ton	12
Tungsten: depending on quality, subject to negotiation, minimum 65% WO_3, per unit for spot	$35—40

New York, November 26

Antimony: per unit, $2.40.

Tungsten: 60%, $45 for shipment this year, and $34 for any time in 1916.

Manganese: 44c. per unit at Rio de Janiero, and 46c. in India.

Molybdenite: 90% MoS_2, per pound, $1.50.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 2.—Copper is quiet, the demand being satisfied; lead is firm but quiet; there are no buyers for zinc and the market is falling steadily.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov. 25	Holiday	Oct. 20	49.53
" 26	56.00	" 27	48.91
" 27	56.50	Nov. 3	49.37
" 28	Sunday	" 10	50.02
" 29	56.37	" 17	50.46
" 30	56.37	" 24	52.35
Dec. 1	56.12	Dec. 1	56.27

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	51.88
June	56.43	49.03	Dec.	49.27	....

Since the rapid advance of last week silver has been a trifle weaker. One reason for the rise is that stocks in London were estimated to be 15,000,000 oz., whereas on November 19 they were only 9,000,000 oz. There is a continuance of demand for English and European coinage purposes. The strength of the market lies in this demand. A. S. & R. Co. stocks are low.

China is an uncertain factor, being a seller and buyer on the same day.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Nov. 25	Holiday	Oct. 20	17.87
" 26	19.62	" 27	17.79
" 27	19.75	Nov. 3	17.89
" 28	Sunday	" 10	18.08
" 29	19.87	" 17	18.58
" 30	19.87	" 24	19.58
Dec. 1	19.75	Dec. 1	19.77

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	18.88
June	13.60	19.75	Dec.	12.75	....

The National Conduit & Cable Co. considers the copper situation stable, but if 18.50c. is to have a good foundation there must be a steady and large consumption; any undue inflation is risky.

October returns were as follows: Chino, 6,319,194; Nevada Con., 5,880,082; Ray, 6,072,497; and Utah Copper, 16,004,607 pounds.

Dividends are $1.50 and 50c. by the Old Dominion, 50c. and 50c. by the Shattuck-Arizona, and $3 (quarter) by the Quincy.

Exports during the week ended November 13 totaled 18,874,973 lb., and imports, 5,623,013 pounds.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Nov. 25	Holiday	Oct. 20	13.37
" 26	19.00	" 27	14.12
" 27	18.75	Nov. 3	14.92
" 28	Sunday	" 10	15.63
" 29	18.50	" 17	17.02
" 20	18.25	" 24	18.58
Dec. 1	18.12	Dec. 1	18.52

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	17.20
June	4.84	22.20	Dec.	5.40	....

Up to $115 per ton was paid for 60% zinc-blende at Joplin last week, but the demand weakened. The output of the region was 6638 tons blende, 1239 tons calamine, and 1058 tons lead, averaging $99.49, $66.94, and $69.55 per ton, respectively. The total value was $821,943.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov. 25	Holiday	Oct. 20	4.50
" 26	5.25	" 27	4.75
" 27	5.25	Nov. 3	4.87
" 28	Sunday	" 10	5.02
" 29	5.25	" 17	5.20
" 30	5.25	" 24	5.25
Dec. 1	5.25	Dec. 1	5.25

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	5.15
June	3.90	5.75	Dec.	3.80	....

On December 4 the Bunker Hill & Sullivan pays dividends No. 219 and 220, totaling $163,500; this makes $16,773,000 to date.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Date.	Week ending		
Nov. 4	97.50	Nov. 17	100.00
" 11	100.00	" 24	105.00
		Dec. 1	105.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	101.50
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	32.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	32.29	39.28	Nov.	33.51	39.50
June	30.72	40.26	Dec.	33.60	....

Tin is easy at 39 to 39.50 cents.

The A. S. & R. plant at Perth Amboy will be ready January 1 to receive Bolivian 'barilla' and Alaskan concentrate. Capacity of 750 tons metal per month will be 1200 tons later on.

Eastern Metal Market

New York, November 26.

Indications point to a period of quiet in most of the metals. In copper an extremely heavy demand has been practically appeased, at least so far as domestic purchasers are concerned. Spelter has been active, but the high prices cannot attract business, and purchases are made only under compulsion. Lead, though steady, is quieter and the purely domestic demand is not what it should be. Buyers are distrustful of the tin market, and for a week they have been inactive. The London market is uniformly strong and this, of course, acts as a sustaining influence on the American market in general. Spot antimony is scarce and strong at 40c. Aluminum holds to its high level. Galvanized sheets and sheet-zinc are higher.

Practically no orders for shrapnel or high-explosive shells are now pending in the United States, although in Canada such orders continue to be doled out. The makers of metal-working machinery are still subject to a heavy war demand—although England is buying less—while orders from the industrial fields are on the increase. Ability to make deliveries alone regulates machinery sales. The steel trade continues to receive orders at a pace with which it cannot begin to keep up. For shell-rounds, up to 4c. per lb. has been paid. It is difficult to keep posted on the quotations of finished steel products, so rapidly do they advance. Shapes and bars are quoted at 1.70c., Pittsburg, plates at 1.90c., but for these and other products premiums are willingly paid. One result of the mounting prices is the withdrawal by the Pennsylvania Railroad of its inquiry for 11,000 freight-cars, and this despite the fact that the Eastern railroads are doing a business the equal of which has seldom been experienced before.

COPPER

Since Tuesday of this week when the quotation for electrolytic went to 20c., 30 days, delivered, or 19.87½c., cash, New York, copper buying has been less active, and there are signs that the big buying movement of the last two weeks is on the wane. That buying should be tapering off is something entirely to be expected. It must come to an end in the natural course of events, and that the time is almost ripe for such a cessation is indicated by the fact that some consumers have closed orders for deliveries of electrolytic running ahead to next June. The producers have booked a volume of orders that places them in a comfortable position. As heretofore stated, the buying began with Europe taking the metal, but in the last few days domestic consumers have been very active, and copper has been sold for a great variety of uses. The wire-mills were notable purchasers. The market is strong at present, and there does not appear to be any valid reason for any substantial decline in prices. Second-hands and some of the smaller producers may attempt to coax business with offerings of the concessions, but the maintenance of prices is as much to their interest as to that of other sellers. With the business they have taken the producers can afford to rest easy for a time; 'sit tight' as it were, an attitude which supports the market. The strength of the foreign market also will be a sustaining influence. Electrolytic was quoted on November 24 in London at £98. Not all of the recent inquiry is satisfied, though the bulk of it has been cared for. The price of Lake copper is nominal at about the same level as electrolytic, a condition brought about by the withdrawal of Lake quotations. Makers of the better grades are comfortably sold up. Leading producers of sheet-copper are not issuing any open quotations, but the base price is about 25c. Exports of copper, from the 1st to 26th totaled 18,433 tons.

ZINC

Steadily advancing prices caused a good-sized amount of buying in the past few days on the part of those who had overstayed the market, and who had contracts which demanded spelter. The resultant activity sent quotations higher still, and on November 23 they were 19c., New York, and 18.75c., St. Louis, for prompt metal. December deliveries were to be had early this week at about 18.25c., St. Louis, and first quarter at 17 to 17.25c. Brass-mill special was quoted around 21c., and the mills engaged on war orders have continued to call for it. The London market has had a strong influence on the domestic situation. The quotation at London on the 26th was £105 for spot-metal, of which Henry R. Merton & Co., Ltd., under date of November 5, said: "Quotations have been marked up day by day, and early material is very scarce indeed. Business in the galvanizing industry has been going from bad to worse, but the consumption there is negligible compared with the quantities of metal required for war purposes." The London market in futures has been erratic, going up £7 one day and losing £5 the next. There, as here, consumers do not feel warranted in buying heavily into the future, even though the quotations for forward deliveries are relatively low as compared with those for prompt. The domestic market became easier on the 24th, and prompt metal was to be had at 18.75c., New York, and 18.50c., St. Louis. Exports have been heavy, amounting from the 1st to 26th to 7716 tons. The price of sheet-zinc, carload lots, f.o.b. mill, on November 26 was 22c. Only about half of the galvanized-sheet capacity of the country is in operation, though the quotations for No. 28 galvanized range from 4.50 to 4.75c. Practically all prices of metal products are subject to immediate acceptance.

LEAD

For some days the domestic demand has been only moderate, at best, but the price at New York has been firm at 5.25c. St. Louis has been quoted at 5.17½c. Not much light is thrown on export sales, but that these have been heavy is undoubted. Shipments so far this month have been large, and would have been greater but for the difficulty of obtaining ocean freight room. Fear is entertained that the high prices which now prevail may lead to over-production, hence a surplus, all of which will tend to bear the market at a later date, perhaps excessively. Exports from November 1 to 26 totaled 5308 tons.

TIN

The stock of spot tin is so small that it ordinarily would create a scare, a rush to buy, and high prices, but the absence of demand is such that quotations have steadily declined. The quotation on the 24th was 39.25c. The situation is explained, at least in part, by the fact that consumers realize that they have been deceived a good many times of late. One rumor after another has been set afloat, not one of which proved to be true. It was falsely stated that the Suez Canal had been closed, that Great Britain was to place an export duty on tin, that the Straits Settlements were short of coal, that tin-bearing ships had been sunk, etc. Consequently, consumers have been holding aloof from the market and business has been almost nil. The arrivals this month total only 2000 tons. There was afloat on November 26, 4298 tons.

ANTIMONY

Spot antimony, Chinese and Japanese grades, is extremely scarce and 40c., duty paid, has been done. Needle antimony is said to be non-obtainable. Business has been confined to small lots of available grades.

ALUMINUM

The market holds steady at 58 to 60c. for No. 1 virgin aluminum, 99% pure.

COMPANY REPORTS

BATOPILAS MINING CO.

This well-known company, operating in the state of Chihuahua, Mexico, has issued a report for the years ended December 31, 1913 and 1914, and for the first eight months in 1915, during which periods operations have been considerably interfered with by the revolution. The American employees, who had returned to Batopilas in September 1914, left again in that month of 1915. The property is now in charge of trusted Mexicans. The report of the consulting engineer, Walter M. Brodie, contains the following:

The output in 1913 totaled 374,174 oz. silver, from 609 tons assaying 411 oz. per ton, and 20,278 tons of low-grade ore concentrated. About 75% of this came from the San Miguel property, where development was satisfactory, as it was in the Porfirio Diaz tunnel claims. Work at the Escritorio, Camuchin, and other mines was not very encouraging. The year 1914 was a bad one, as the revolution was at its height, but the company has been treated with great consideration by the people. J. R. Harbottle, the present manager, arrived in September of 1914. The bullion output by the company was 188,087 oz., from a total of 6635 tons of mixed ore. Development from September to December totaled 1206 ft. To August 31, 1915, the yield this year was 158,862 oz. Work has been resumed at the mines, stamp-mills, and cyanide-plants.

The profit in 1913 was $60,068, and in 1914, $10,556, a total of $70,624. Previous surpluses left a balance of $3,365,771 at the end of 1914. On October 15, 1915, the company had $87,247 cash in New York banks, and ₱47,500 Mexican currency and coin.

AMALGAMATED ZINC (DE BAVAY'S) LTD.

The report of this company, which treats Broken Hill tailings by flotation, covers the six months ended June 30, 1915.

During the period 156,196 tons of material was treated for a yield of 43,468 tons of concentrate, assaying 49.3% zinc, 5.5% lead, and 7.8 oz. silver; also 420 tons of concentrate, assaying 58.5% lead, 57.9 oz. silver, and 11.7% zinc. The mill was in operation for only 21 weeks, and the average production in respect of actual running time was 2070 tons of zinc concentrate per week.

No sales were made during the last two half-years. Contracts have been made covering the sale of 70,000 tons of concentrates at higher rates, consequently the profits on the production of the past twelve months will be eventually increased by approximately £155,000. The final figures will be available only on completion of delivery at the respective ports of discharge. So far, 33,000 tons has been shipped. Ninety per cent of the sale price is paid at port of destination, the balance later. Including revenue derived from dividends on shares in other companies, interest, rents, and exchange, and after deducting administration, income-tax, and all other Melbourne and London charges, the net profit (taking spelter at 4.5 cents per lb.) for the half-year was £21,999.

The surplus of assets at June 30, 1915, was £164,289. In the assets no account has been taken of tailings already paid for, but not yet treated (£101,483), nor of the 119,250 shares in Minerals Separation and De Bavay's Processes Australia Propy. Ltd. The accumulations of zinc and lead concentrates at the end of the term were 76,017 and 1479 tons respectively, the result of the War upsetting markets.

Metallurgical results were improved. The quantity of material treated by this company's process since it was installed is 2,562,000 tons, and the concentrate produced 730,000 tons, averaging 49% zinc. While the general manager, H. W. Gepp is in America, David Meredith is in charge.

Commercial Paragraphs

The Alaska Juneau Mining Co., Crocker building, San Francisco, through its managing director, J. H. McKenzie, and its consulting engineers, Messrs. Bradley, Bruff & Labarthe, have placed the following contracts for equipment for their new mill:

Westinghouse Electric & Mfg. Co., two 18-ton articulated electric locomotives, 30-inch guage of track.

B. F. Sturtevant Co., two high pressure fuel-economizers.

General Electric Co., one 9-stage Curtis turbo-generating set, 6000 kw., with direct-connected exciter.

G. C. Buchanan Co., one 36-in. by 48-in. Blake type all-steel jaw-crusher.

Power & Mining Machinery Co., two 4-compartment revolving car-tipples.

Babcock & Wilcox Co., through Chas. C. Moore & Co. of San Francisco, four class M, No. 30, Sterling water-tube boilers, with 826 sq. ft. of heating surface, each end equipped with Babcock & Wilcox steel super-heaters, working pressure 250 pounds.

Bonnot Co., twelve 8-ft. by 6-ft. ball-mills.

Petroleum Iron Works, through the Dorward Engineering Co. of San Francisco, one 55,000-bbl. capacity, steel fuel storage-tank.

Allis-Chalmers Mfg. Co., four No. 9 Gates type K gyratory crushers.

Kansas City Structural Steel Co., contract for the furnishing and erection of steel for buildings, aggregating 2500 tons.

Deister Machine Co., complete equipment of concentrating tables (150) and classifiers.

The value of all contracts placed as above is $458,864, f.o.b. factory, except where specified otherwise.

The Roessler & Hasslacher Chemical Co. of New York announces that its exhibit of cyanide at the Panama-Pacific Exposition, San Francisco, was awarded the gold medal.

In constructing the Arrowrock dam in Idaho, over 100,000 ft. of Leschen Hercules, plow and cast-steel wire rope, of ¾ to 2¼-in. diameter was used. One of the main cableway lines was a 2¼-in. locked wire rope.

The Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, sends us Bulletins 1097, 1435-A, 1636, and 1801-A, dealing with power-transformers, vertical mill-elevators, hydraulic machinery, and the Isbell vanner. The descriptive matter and illustrations are of considerable interest.

The Morse Bros. Machinery & Supply Co. has purchased the entire plant of the Kuenzel process smelter at Buena Vista, Colorado, and will dismantle and ship it to Denver. This plant was never completed, and only parts of it were in operation. It is a complete power-plant of high-pressure boilers, engines, blowers, compressors, crushing-plant, machine-shop, fire and boiler feed-pumps, shafting, elevators, etc.

In English, Spanish, and Portugese, the Pelton Water Wheel Co. of San Francisco has published brief notes on the use of its wheel. This is intended to direct the attention of machinery users to the possibility of using Pelton drive for every class of apparatus, and also to more particularly instruct people living in remote districts where electrical energy is not available to the possibility of using a small stream for the supply of light, heat, and power through the medium of the Pelton system.

The company announces that Benjamin B. Lawrence, a member of the class of '78, has purchased the Pelton-Doble water-wheel and the Pelton-Francis turbine which were exhibited by the firm at the Panama-Pacific Exposition, and presented these to the Columbia School of Mines.

EDITORIAL

T. A. RICKARD, Editor

IF you want to be featured as an engineer of international fame, go to a boom camp and say kind things to the local reporter. If you want to find what a poor thing is fame, watch the incorrect spelling of your name in the local paper next day.

WE note that a committee of ten geologists, selected by the National Academy of Sciences, at the request of President Wilson, sails today from New York to the Panama Canal, in order to investigate and report upon the earth movements that have blocked the big waterway. The committee consists of Messrs. C. R. Van Hise, chairman, H. L. Abbot, John C. Branner, Whitman Cross, John F. Hayford, H. F. Reid, Charles D. Walcott, R. C. Carpenter, A. P. Davis, and John R. Freeman. The personnel of the committee is admirable, but why so many?

ON December 16 a convention of mining men is to meet at Washington for the purpose of urging upon Congress the necessity for revising the mining laws of the United States. This meeting is being held under the auspices of the Mining and Metallurgical Society of America, with the hearty co-operation of the American Institute of Mining Engineers and the American Mining Congress. The several sessions will be open to all persons interested in the industry of mining, but the right of voting will be limited to accredited delegates. We would suggest that our readers send telegrams expressing sympathy with the movement to the secretary, Mr. F. F. Sharpless, care of the Bureau of Mines, Washington. We shall do so.

THE latest re-arrangement of Guggenheim interests covers a wide area. It is proposed that the Kennecott Copper Company shall absorb the shares of the Braden Copper Company, the Guggenheim Exploration holdings of Utah Copper, the Alaska Steamship Company, and the Copper River railroad. This agglomeration of diverse properties may excite the cupidity of the public because the Bonanza mine of the Kennecott Copper Company is making big profits, available for dividends, on the realization of limited reserves of extremely rich ore, aided by the high price of copper. One apparent result is the disposal to the public of the Copper River railroad, which the Government did not buy, preferring to build the alternate line from Seward. This marketing of the railroad, which otherwise would be a loss, represents the obvious gain, to the Guggenheims, of this complex financial arrangement. Moreover, the delay in payment of dividends by the Braden, entailing probable further financing, will be covered by the immediate distribution made possible on account of the profitable operations at the Bonanza copper mine. Speaking generally, it may be assumed that such consolidations are made more to cover some deficiency than to improve operating efficiency.

IN rock-drilling and shaft-sinking practice the Lake Superior region takes the lead. Both the copper and the iron mines are excellent exemplars of progressive technique. Elsewhere in this issue we publish a description of fast driving in a mine of the Cleveland-Cliffs Iron Company. In this particular case, speed was essential. Therefore the ordinary tram-cars for hand-tramming were replaced by the large motor-haulage cars used for taking ore from chutes. Shoveling over the 5½-ft. side of these cars was severe work. Hence the company built in its shops the portable underground loader described. The total cost of this loader, including the 5-hp. motor, was $500. Such a loader can be built in any well-equipped mine-shop, and would undoubtedly be of service where speed of driving is desired. Efficiency-engineers will note that six shovelers were employed per shift instead of three, so that one gang could 'spell' the other; that is, the theory of rest-intervals, as promulgated in Taylor's system of scientific management, was used. Where speed is important and where the work is particularly tiring, there is no doubt that a double gang of workmen to relieve each other is worth while. The use of 80% dynamite, in this case for rock where the drift paralleled the slips, corresponds with the tendency of modern practice to use higher explosives. The method of blasting in two sections is a noteworthy feature; the miners on each shift completed the cut, making an average progress of over 12 feet per day of two shifts. The cost of $10 per foot is significant; of this $6.18 was for labor both underground and in the shops, and $3.82 was for supplies, the items including $2.33 for explosives, 24 cents for air, 40 cents for machine-repairs, and 3 cents per foot for carbide.

THE notes from the *Mining Magazine* concerning underground practice on the Rand, printed elsewhere in this issue, as to drilling short or long holes and the difference of gauge on successive lengths of steel, are most timely. Much the same problems of rock-drilling practice are engaging the attention of engineers and superintendents in this country. However, in several respects, results are being obtained in America almost exactly opposite from the trend of the conclusions stated to have been reached in South Africa. With high-grade intelligent miners as opposed to Kaffirs, American managements are favoring water-hammer

drills and hollow-steel, particularly in large mines where the rock is of medium hardness. Also, strangely enough, we are tending to drill longer holes for stoping, employing a decreased difference of gauge on successive drill-bits, even as low as $\frac{1}{16}$ inch. This practice of stoping on a larger scale, breaking a greater quantity of ore at one blast, has been aided by the use of special drill-bits (such as the Carr and H bits), making long holes possible because of their superior wearing qualities. Another factor now recognized is that it is more efficient to break down a large mass of ore in a stope by one big blast, even if the broken material should require block-holing, than to break ore in a stope by the old-fashioned small-scale methods necessary in driving. Again, American experience with hollow-steel appears more fortunate than in South Africa. Indeed, operators here have found it possible to decrease the difference in gauge of successive bits when using hollow-steel with mounted hammer-drills, in part because the hammer principle obviates the necessity for the reciprocating movement of the steel in the hole with a tendency to hit or rub against the sides. Another difference to be considered in comparing Rand with American practice is the extreme hardness of much of the rock in the South African mines; thus on the East Rand it is considered good practice if a small stope-drill can drill six or seven 6-ft. holes in one shift. This would be considered a poor performance in most American mines, although here again the difference between Kaffir labor and high-priced white miners is clearly evident. The entire subject of rock-drilling in all its details is arousing keen interest at this time, giving promise of useful economic results.

TUOLUMNE county, California, is attracting attention, as is shown by recent transfers of property. The old Rawhide mine, near Jamestown, formerly owned by Capt. W. A. Nevills, is being unwatered and re-opened by the Pittsburg Silver Peak Company. The mine was examined and re-opened on the recommendation of Mr. Duncan MacVichie, and will be operated with Mr. John Mocine as manager. A new head-frame has been erected, an electric hoist installed, and a new electric sinking-pump is to follow in a few days. The shaft is 1800 feet deep, on the incline, and has been idle for fifteen years. The mine was a famous producer, having yielded over $6,000,000. The Republican and Mammoth mines, near Jacksonville, have been taken over on a bond and lease by Mr. James T. Currie, of London, with Mr. F. W. Paige of Hodson as manager. These mines contain a large tonnage of low-grade ore and will be operated on a proportionate scale. Some high-grade ore has been produced in the Republican mine, which should afford a fine prospect. The Dutch, Sweeney, and App mines are being developed by Mr. W. J. Loring, of London, representing Boston capital. A new compressor is being installed at the Dutch mine, and the 40-stamp mill is being remodeled. Levels are being run from the Dutch to the App mine, the former being 1800 feet deep while the latter is only 1300 feet, so that exploratory work can be hastened. Other business is under negotiation by representatives of capital. All of which is highly gratifying to the people on the Mother Lode, of which Tuolumne county covers an important part. This famous mining region extends from the Cosumnes river to the Merced, a distance of 90 miles, across the foot-hill counties of Amador, Calaveras, Tuolumne, and Mariposa.

The Passing of the Exposition

Last Saturday, on the shore of the Golden Gate, one of man's greatest creative efforts came to an end. The gates of the Panama-Pacific International Exposition were closed and the work of demolition begun. A sum of $50,000,000 had been spent on the buildings and exhibits, the turn-stiles had counted 18,800,000 entrants, and the great show had been in evidence from February 20 to December 4. The time, the money, and the multitude were of impressive size. What was accomplished?

As a foregathering of the nations, the Exposition failed because the chief countries of Europe happened to be at war. Some of them were not represented by exhibits or were represented on a scale entirely disproportioned to the part they have played in the progress of the race. The pavilions enclosing foreign exhibits and the officials in charge of them served to give a slight flavor of internationalism, sufficient to emphasize the magnificent display made by the home country as a whole and also by the individual States. If the enjoyment of this wonderful display of the peaceful arts was marred by the reverberations of the organized calamity in Europe, the dominant thought among the visitors to the Exposition was not that they were fiddling while Rome was burning, but that the scene afforded a grateful contrast to the horrors of Armageddon. The War reduced foreign attendance, except from South America, to insignificant proportions, but it served to divert American tourist travel to California and caused many thousands to visit the Pacific Coast for the first time. Yet the bulk of the attendance came from the West, more particularly from California and the contiguous States. The Exposition was a pleasure ground, a gallery of art, a museum of industry, a marvel, and an inspiration to millions that had never had a chance to see such things before, and never will again. The pulse of the wearied globe-trotter might not be accelerated by the sights and sounds that had sprung into radiant being in the fairy-land created on the shore of the Bay of San Francisco, but to the farmer from the interior valleys, to the miner from the mountains, to the clerk from the village store, to the school-teacher from among the pinewoods, to such as these, the real people, the experience was one never to be forgotten. In a brief pause from familiar tasks they came wondering to the City of the Sunset, they wandered amid its courts and palaces, absorbed its tranquil beauty, read history in its inscriptions, glimpsed the allegory of its statuary, revelled in the frozen music of its architecture, gloried in the human achievement, rejoiced in the American accomplishment, and then journeyed home to treasure in their souls a memory that

will not die. Dreams are real while they last. This is

"A dream that shall not altogether die,
The vision of that day
When human strength shall serve the common good."

Co-operation, the momentum of joint effort, was the dominant note of the successive congresses that were convened during the period of the Exposition. The solidarity of feeling engendered by such meetings and interchanges of ideas may have gained by a side-long glance across the Atlantic, where the forces of disintegration seemed to be let loose. The use of the Exposition as a point of convergence for scores of professional, scientific, and benevolent organizations contributed to a rich increase of mutual acquaintance and goodwill. More particularly it afforded the people of the Pacific Coast and the countries bordering the Pacific Ocean an opportunity to compare notes. The islanders of the South Seas shook hands with the mountaineers of the Sierra Nevada; the Orient met the Spanish main on the hearthstone of America. From such commingling of the peoples will come social gain and industrial enlightenment. Among the particular events marking human progress was the beginning of telephonic communication across the continent and the opportunity afforded to visitors at the Exposition of speaking with their friends upon the Atlantic coast.

Was it worth while to spend $50,000,000? The question hardly needs further answer. Not as an advertisement of products, for most of those who came cared more for the pictures, the music, and the fireworks than to inspect the exhibits of the manufacturer; not as a place of idle amusement, for the arrangements for dining were poor and the banalities of the Joy Zone are best forgotten; but as a stimulus to the appreciation of beauty in art, to the widening of imagination, to the awakening of interest in new phases of human life—in these respects the Exposition repaid its organizers and enriched its beneficiaries. It was a liberal education to the multitude. In most cases the curiosity of the visitor was assuaged by the ready information of those in charge of the exhibits. The pictures told their own story, except those of the futurists and other cryptic artists; but it may be inferred with confidence that the lavish display of statuary aroused the poetic sensibilities that lie dormant even in the most practical mind and opened a new horizon to those of narrow groove.

And what did it prove? It proved that the men of San Francisco know no such word as fail. After the earthquake-fire they began to rebuild their city while the rest of the world was still wondering whether they could recover from the disaster. When they made plans for a celebration to mark the completion of the Panama Canal, the signs were propitious. But the Great War threw its dark shadow athwart their purpose. The Canal itself was blocked by landslips, so as to render traffic intermittent. Even the weather at first was unfavorable. Nevertheless those in control of the Exposition threw themselves into their work with keen intelligence and inexpugnable courage. They won. Seven months of superb weather aided them. The Exposition proves the unconquerable spirit of the Argonaut breed and the unexcelled beauty of the Californian climate.

"So fades that city, one with all that finds
The nameless road that Beauty takes at last—
One with her dust upon the twilight winds,
And all her music mingling with the Past."

Preparedness

Among the efforts to understand the vital question of preparedness for war, defensive or offensive, we may mention the investigation and report of the Union League Club, of New York. The fact that this work was done largely on the initiative of Mr. Christopher R. Corning, a distinguished mining engineer, simply serves to accentuate the fact that the defence of the country is a question in which the engineering profession is keenly interested, not only as thoughtful citizens, but as men that have undergone a training particularly serviceable for the purpose in mind. Copies of the report can be obtained from Mr. Corning at 36 Wall Street, so we need not quote from its many surprising statements, all proving unmistakably that the situation in this country is even worse than it was in England before the War. At least, England had a great navy, ready for action, while the United States is relatively worse prepared to protect itself from naval attack than it was a decade ago. A strong navy is a factor for peace, being mainly a weapon of defence and of protection to commerce. We hold that the United States should prevent not only danger to its life but threats to its peaceful industry, by establishing adequate naval protection from either invasion or piracy.

There is another kind of 'preparedness' for which we can plead with greater confidence. There are wars of tariffs as well as of armies. This country can, and will, keep out of the War, but it cannot escape the difficulties of trade created by active belligerency. When hostilities cease, there will be a scramble for business under new conditions, marking a divergence of many of the familiar currents of commerce. To young men we would say: learn Spanish. Great opportunities for American initiative will be offered in the countries of Central and South America. It may be that new openings, more especially work for mining engineers, will be available in Siberia after the War. Here also the knowledge of the language of the country is an essential equipment. For chemical engineers and for metallurgists, the War will furnish new opportunities. The necessities of the times, when the ordinary exchange of commodities is blocked, have caused inventive genius in Europe to find many subtitutes for materials and things heretofore purchased in America. Similarly a cessation of supplies of special chemicals or other manufactured products has caused our own people to invent substitutes. The general result is an upsetting of conditions and the necessity for envisaging a new order of things.

And there is yet another 'preparedness': disciplined

patriotism, a conscious social control as against a policy of drift. The War, despite its horrors, has shown how the soul of a people can be awakened to identity of interest and community of effort. If only a fraction of the wealth spent in munitions and a tithe of the unselfishness shown in the trenches could be perpetuated for service in the cause of social betterment, the world would have something to show for the bloodshed and suffering incidental to organized murder on a colossal scale. The subordination of individual desire to national purpose is a remarkable feature of the War, especially when viewed at a distance by a people of energetic individualists such as we are. The lesson conveyed by the spectacle should not be lost. The industrial conflict between capital and labor shames our material civilization as much as the howitzer and the submarine. It is a blight on democracy. Let preparedness for war go hand in hand with preparedness for peace. Preparation to die nobly is hardly less desirable than the preparation to live usefully.

Smelter Fume

One man's food is another man's poison. To the miner the smell of smelter smoke is a reminder of the profitable reduction of ore; to the farmer it is an irritant to throat and temper, and an agent of possible destructiveness to crops or cattle. During the last decade we have heard much of the clash of interest between smelters and farmers, with claims and counter-claims that indicated a gross misapprehension of facts on both sides. It is a relief therefore to turn to the report of the Selby Smelter Commission, recently published, and read the findings of an impartial tribunal, selected by the joint consent of the two parties in the case, namely, the Selby Smelting & Lead Co. on the one side and the people of the State of California, or, more particularly, the citizens of the county of Solano, on the other side. Protracted litigation, culminating in a decree of injunction, dated March 14, 1905, had brought matters to a crisis and threatened to terminate the useful activities of the chief smelter in California, when a conference between the attorneys representing both sides led to the submission of the question of fact, as to the violation of the injunction, to a committee of unprejudiced technical men. By a stipulation signed March 16, 1913, the complaint of the supervisors of Solano county was referred to a commission headed by the late J. A. Holmes, then Director of the U. S. Bureau of Mines, assisted by Messrs. W. F. Snow and Ralph A. Gould. Subsequently Dr. Snow retired in favor of Mr Edward C. Franklin, professor of organic chemistry in Stanford University. Mr. Gould is a chemical engineer resident in San Francisco. By leave of the Secretary of the Interior, the staff of the Bureau of Mines was placed at the service of the Commission. Among several contributions to the inquiry, we may mention the experiments of Mr. A. E. Wells on the effect of fume on vegetation and the investigation conducted by Mr. C. B. Dutton into the personal injuries alleged to be due to smelter smoke. The report contains much interesting information and establishes an excellent precedent for the settlement of similar disputes arising from the interference between neighboring industrial operations.

The conclusion, briefly summarized, is that visible smoke did injure horses prior to April 1914, when the new bag-house was built to filter the gases from the sintering furnaces. Lead and arsenic from this smoke were deposited on soil within the smoke zone, but in quantity so small as not to poison the soil or otherwise injure crops. With respect to the invisible fume—sulphur dioxide—it is found that the smelter did not maintain a nuisance, either by making bad smells or by economic damage to trees, shrubs, or crops. Finally, it is agreed that the mechanical devices now in use at the smelter are adequate to prevent such injury as may have been done in the past, but that to ensure the prevention of any sort of nuisance in the future the smelter management should observe sundry minor restrictions, specified by the Commission. Thus it is found that the smelting company was violating the terms of the injunction at the time when the Commission was organized, and was maintaining a nuisance, more particularly with respect to the injury to horses, but that by the addition of proper apparatus for the elimination of the visible element in the smoke, the smelting company has, since April 1, 1914, complied with the terms of the injunction "both in letter and spirit."

The report affords interesting evidence of the psychology of the case, showing how the residents of Benicia, across the strait on which the smelter stands, had become so prejudiced as to smell smoke when the plant was not in operation or when the sulphur dioxide was diluted to an extent quite beyond the possibility of detection by the most sensitive nose or throat. On the other hand, the Smelting company paid claims for horses reported to have been killed by the fume without investigating the cases, and thereby adopted a policy of "buying off" trouble. Not only did this encourage blackmail, but it became a cause of ill-feeling toward the rich corporation owning the smelter. Undoubtedly the average man resents bitterly the employment of money to suppress complaints, whether reasonable or not, realizing that the commercial method of abating trouble leads to all sorts of iniquities. As the Commission suggests, this misuse of money in attempts to silence protest from the farming population is responsible for much of the unreasonable dislike shown toward smelters by the neighboring communities. In the report it is stated: "the principle that right is on the side of the man with the biggest gun is fast becoming an obsolete idea in modern business and is being replaced by equity and open and above-board dealings." These last words describe the present policy of the Selby Smelting Company, which, by its willingness to arbitrate the matter, has shown good sense as well as public spirit. The lesson will not be lost on either of the two disputants, while to the Bureau of Mines the joint communities of mining and farming are under renewed obligation for a public service well done.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

An Early Ball-Mill

The Editor:

Sir—As a further proof of the correctness of the saying that there is nothing new under the sun, I submit for your consideration a photograph taken by me on the Mariposa Estate, belonging to the Mariposa Commercial & Mining Co., in Mariposa county, California, of a so-called Lundgren pulverizer, which is described by J. Ross Browne in his report on the Mineral Resources of the States and Territories West of the Rocky Mountains, made to the Secretary of the Treasury, March 5, 1868, page 30:

"The Bear Valley mill has 12 stamps. At this mill the Lundgren pulverizer and the Ryerson amalgamator are now being used. The Lundgren pulverizer is a barrel five feet in diameter and three feet in length made of boiler-iron three-eighths of an inch thick, heavily riveted. Inside, the barrel is shod with iron an inch thick. A door a foot wide and two feet long is placed lengthwise on the side of the barrel. There are two of these barrels at the Bear Valley mill and the cost of the two with their gearing was $2300, but if many were demanded they could no doubt be made for $1000 each. The barrels revolve horizontally, making 24 revolutions per minute and requiring a six horse-power engine for two of them. A charge is 800 pounds of quartz and 2400 pounds of ounce musket-balls made of chilled iron. The quartz previous to going into the barrel is crushed to about the size of grains of wheat and after being in the barrel one hour comes out an impalpable powder as fine as the finest flour. The powder is so fine that if it were pounded dry in the open air much of it would float away. The thoroughness of the pulverization is claimed to be the great advantage of the machine."

A RELIC FROM EARLY DAYS.

The present ball-mill, for which so much is claimed, is only an improvement of the Lundgren. This is another proof of the fact that many of the appliances for mining in the early days, while crude, were steps in the direction which we are traveling at this late date.

W. C. Ralston.

San Francisco, November 23.

Flotation on Dump Ore

The Editor:

Sir—On the eve of my departure from Australia I received a copy of your issue of July 31, in which considerable prominence was given to the subject of flota-

tion; and it has occurred to me that the following may be of interest to some of your readers.

Early last year I was commissioned to re-organize the work of the Lloyd Copper Company at Burraga, New South Wales, and, upon my arrival there, found that the concentration mill had been equipped recently with tube-mills and a flotation unit. I need not go further into the description of the plant than to state that when I assumed command the output of the mine and of the smelters was limited by the capacity of the mill, which was not working as well as it should have been doing. Attention was, of course, first given to the mill, which so well responded to the efforts made that before long it outstripped the supply from the mine, which was suffering sadly the consequences of lack of development. In the meantime I had made laboratory tests with regard to the flotation of the tailing lying on the dumps and had also sent away samples for trial at the experimental works. The results obtained from all sources showed that the sulphide in the tailing had become so oxidized that it had become totally unsuited for the ordinary process of flotation. However, before finally dropping the matter, I decided to give the tailing a bulk test and fed it to the mill during the ordinary course of crude-ore concentration. By this procedure I obtained such satisfactory results that dump-tailing was put through the plant with the crude ore whenever a shortage of the latter was anticipated. In order to find out definitely what recovery was being made from the dump-tailing, apart from the mixture of tailing and crude ore, an eight-hour run on tailing by itself was taken in hand. For the first two hours of the run everything went satisfactorily; but afterward the froth began to thin, and, finally, at the end of four hours there was no flotation at all, the particles to which the flotation bubbles were attached rising only part way to the surface in a manner similar to that which I had observed in my initial experiments on the flotation of zinc-blende by the Potter process at Broken Hill in 1902. The addition of sulphuric acid and other chemicals to the eucalyptus oil, which formed the frothing medium, had no beneficial effect.

At the end of four hours crude ore was put into circulation in the mill again; and very shortly afterward frothing recommenced, with the result that the flotation of the mixture of crude ore and tailing proceeded satisfactorily. Similar results were obtained during all the subsequent trials.

As my records are stowed away in the hold of this steamer, I am not, at the present moment, able to give accurate figures as to the recoveries obtained.

In smelting the flotation concentrate great losses were at first encountered. A big proportion by weight was lost in the roasters and again when the calcined concentrate was charged into the reverberatory furnaces. Clouds of calcined flotation-concentrate could be seen issuing from the top of the chimney-stack whenever the feed-hoppers containing the calcine were opened and the charge dropped into the furnaces. All kinds of devices were tried to overcome these losses, but they proved unsuccessful. As a final resort the 'green' concentrate, after having been well drained, was fed through the side doors (the rabbling doors) of the reverberatories and this procedure was ultimately adopted with satisfactory results. As the reverberatories frequently got ahead of the output of the mine and mill, they were, from time to time, used as roasters by being fully charged with 'green' flotation-concentrate and run with open doors for several hours until calcination had been completed.

I may add that at the works of the Wallaroo & Moonta company it has been found convenient to add to the top of each charge in the blast-furnace a definite quantity of 'green' flotation-concentrate, which sinters as the charge sinks and reaches the solidified stage before entering the strong blast area.

V. F. Stanley Low.

R. M. S. *Ionic*, October 1.

Prospectors, Engineers, and Amateurs

The Editor:

Sir—The Press of October 2 is at hand with its most interesting as well as entertaining letter from Mr. Richardson and your timely editorial reference to his letter. Reading these and the original editorial, 'The Amateur Miner,' in your issue of July 31, I am led to reflections on a series of correspondence, editorials, and technical dissertations that while differing in their purport have led to the same conclusion: the lack of new mines.

Five or six years ago readers were presented with numerous articles on how to sample a mine, these appearing under various titles. Some of these were admirable, assuming that you had a mine to sample. Indirectly but unquestionably they have influenced the prospective investor, also the development expert, until a general impression was created that the imposed conditions must be met for a safe investment. The result has been that nothing could pass muster but such a property as could present definitely blocked-out orebodies of definite value with prescribed mining and milling costs, and upon which the engineer can put a value, such as a lumberman would put upon a tract of saw-timber or a lumberyard. This did not preclude transactions in mines, but it did not bring in new mines.

Time passes: the pendulum continues in its swing, and the discussion merges into the query on the causes of the decline in prospecting. That this phase of mining has attracted more than passing interest is testified by the extent of the discussion and the prominence of the participants. Manifestly something was wrong, and many were the causes assigned therefor. No doubt some, possibly all, of the causes mentioned exercised influence, but there has been a master-key to the situation. Situated as I have been, intimately in touch with the prospector and the owner of the small undeveloped mine on the one hand, while, on the other hand not infrequently in the field with the investigating engineer, I have been forced to the conclusion that the largest factor in

inducing the so-called decline of prospecting has been the inability of the owner to market his prospect or undeveloped mine, for the simple reason that the requirements could not be met. In presenting reports on such properties, I have had them referred back, for property-maps, assay-maps, smelter-returns, photographs, estimates of tonnage, value of tonnage, etc., though, in the original, I had specifically stated that it was impracticable to furnish such data. Most of these engineers have insisted that there should be enough ore assured to justify the price of the property, interest on payments to be made for an arbitrary period; they have demanded the cost of mining and extraction, cost of equipment, interest on equipment for an arbitrarily set period of life, and on top of all of this, that "we should have a reasonable profit from the operations." With your editorial I can ask, have I not protested against the attempt to appraise mines on an investment basis?

Who will 'bring in,' to use the oil-well phrase, the new mines? The prospector is not able, the widow of the old-time prospector who left some patented claims as his legacy to his family, has not the means. I know she has good claims, I have advised capitalists to accept her offer and develop them, but will they, in the frame of mind superinduced by the impressions gained as mentioned above, consider such offerings? Not yet. But still the pendulum continues in its inexorable swing, the light is beginning to dawn and we may yet hope to see the day when there will be those, who, perhaps not like the old time 'adventurers' you mention but others with a keen mining business sense, will take up and 'bring in' the mines to be.

I do not agree with the man who says there are no prospects or mines to take hold of, that they are getting scarce. Our state offers many of these to the man who will leave his slide-rule and tape safely locked in his desk, and get out into the field with a sound experience, common-sense, and again quoting from your editorial "also some sort of instinct, based partly on inherited qualities, partly on experience, partly on keen powers of observation." Such a man will be invaluable to the investor who undertakes filling the gap now existing between the prospector, and the 'Development,' 'Mining,' and 'Exploration' companies of the day. This investor has the right to demand from such an engineer his opinion, and to receive it. Mr. Richardson says that if he were an engineer he would turn down the Little Tinker cold, and asks if you or I would recommend the Homestake, then or now? Honestly, if the engineer would spend his own money on the property under consideration, has he any right to turn it down cold, to his client, to Mr. Amateur Miner?

Finding fault without suggesting a remedy gets us nowhere. I would suggest to the 'Amateur Miner' and the many of him with whom the country is filled, that his capital may be well and profitably employed in filling this gap. Let him seek out an engineer who is honest, who knows his country, who knows the prospectors, the undeveloped mines of his 'stamping-ground,' and with him look over the field and select a few promising properties for exploitation. Judgment will dictate the spending of a few hundred dollars on this one, more money with encouraging results, or on the contrary, its rejection; a few thousand on No. 2, something on No. 3, taking or rejecting. On those selected, as standing the test of this preliminary investigation, proceed with development, open up, block out, map, sample, photograph, put up a test-mill, if advisable, and then say to Mr. Development Company: "We have a MINE for sale, here is our engineer's report—or that of some 'favorably known' engineer—we will sell it for so much, you may send your examining engineer, if you are in the market for a mine." Thus will Pap Brenegan be reincarnated in the modern business-man looking *for* a mine, not *forninst* one.

LEVERETT S. ROPES.

Helena, Mont., October 11.

Everson

The Editor:

Sir—May I add a few words to the editorial note in your issue of November 20, referring to Carrie J. Everson?

The investigation respecting her was initiated by the Colorado Scientific Society, which appointed a committee, consisting of Philip Argall, H. C. Parmelee, and the writer, to find out all that could be learned respecting her, and to suggest some means of commemorating her discoveries in flotation. The committee is still engaged in its work, and naturally would have preferred to defer any public presentation of its findings until ready to render its report. Unfortunately an ingenious newspaper reporter got wind of the affair, interviewed one of the informants whom we had located, and made up a characteristic 'story' which has been widely disseminated.

It is true that Carrie Everson is dead: and probably much of the history of the inception of the flotation processes has died with her. The later Everson-Hebron patent seems to mark rather a regression than an advance on the first patent. After the death of her husband, who was a Chicago physician, Mrs. Everson worked as a nurse, in order to support her son and herself. The friends who knew her at that time, speak most highly of her character and intelligence.

So far as we have been able to ascertain, she was not a school-teacher; and the story of her having discovered the efficacy of oil-flotation while washing ore-sacks in her brother's assay office is apocryphal.

GEORGE E. COLLINS.

Denver, November 27.

GEORGE STERLING has a beautiful poem of farewell to the Exposition in the December issue of the *Sunset* magazine. This poem is of higher quality than the one read during the closing ceremonial. The lines quoted in our editorial on the subject are his. The verse on the front cover is by William Watson.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

Fuse burns at about 90 seconds per yard or half a minute per foot. A variation up to 10% either way has to be expected.

Magnesium is used in the manufacture of copper castings to prevent blow-holes by decomposing the gases formed in melting the copper.

Smelting and production of charcoal wrought-iron has been continuous at the Laxo Bruks Aktiebolag, at Laxo, Sweden, since 1642. The fires have never been out in the works.

The most northern railroad in the world is to be strictly an electric one. It is in Lapland, near Porjus falls, where the power-plant costing $5,000,000 was built by the Government. It is expected to transport iron ore from the great Arctic iron mines.

In turkey copper utensils constitute a form of savings-bank among the poorer classes. What money they can spare is invested in copper utensils as an addition to their stock, and when in need of money they sell what can be spared of their copper according to their needs.

Condenser water from steam-engines must be cooled before re-use. Several systems are used for this, including ponds, towers, and sprays. All have their advantages, those for the last named being saving in power, flexibility, less make-up water required, longer life, and lower first-cost.

When gold-quartz veins occur in slate, the slate walls usually carry iron sulphide which is gold-bearing, but to a less extent than the sulphide in the quartz. This sulphide in the slate is less massive than that in the quartz, and generally more flaky, sometimes requiring sizing or classification before concentrating.

Roller-bearings have two principal designs, one for straight radial loads and one for combined radial and thrust loads. Worn bearings cannot be adjusted satisfactorily; the rolling members and the races never wear equally, so that tightening a worn bearing, in order to eliminate the play, will jam some members while others will be loose, eventually destroying the bearing.

Water, not low temperature, causes the deterioration of roads in winter, according to road specialists of the U. S. Department of Agriculture. Cold weather does not in itself injure roads, no matter whether they are earth, gravel, or macadam. In fact, an earth road will stand more traffic when it is solidly frozen than at any other time. Excess water, however, is always detrimental to a highway. When cold weather turns this water into ice, the damage that it does is greatly increased. If the road, when winter begins, is thoroughly dry, with the surface and drainage in good condition, the chances are extremely favorable that it will come out all right the following spring.

A mine-superintendent writes to say that the ore being hoisted is so muddy that the hand-picking by boys on the picking-table in the shaft-house is much complicated. The mud is a result of the water from the Leyner drills that washes down a chute onto the broken ore. Some new raises now being driven for ventilation will take care of the mud, obviating the difficulty.

The Shattuck mine in Arizona contains a variety of ores in commercial quantities, including many forms of copper, lead, and vanadium. One of the sights in the mine is a cave, dome-shaped and white, 270 ft. long, 180 ft. wide, and 170 ft. high. The roof is covered with heavy stalactites, and the floor is composed of large and small crystals, in appearance like a coral bed, out of which rise magnificent stalagmites to the height of 20 ft. or more.

Grouting is now a recognized method of stopping flows of water in shafts, adits, and drifts. A mixture of cement and water (perhaps a bag of cement to three 12-qt. pails of water), with sometimes a little sand, is forced by a grout-machine into holes drilled in the rock, the pressure being furnished by compressed air. Pressure of 100 to 200 lb. above the hydrostatic head is used in difficult shaft problems. The Nova Scotia Steel & Coal Co., in its iron mine at Bell Island, Newfoundland, where the mine workings are several miles out under the ocean, has a grout-car run on wheels that can force grout into rock at a pressure of 700 lb. per square inch. By use of this grout-car the workings, although under the Atlantic ocean, are kept fairly free from large flows of water.

Rock-drilling practice on the Rand is criticized by E. M. Weston as follows: "In general the stoping practice and efficiency are much below what is believed to be possible. It is not known whether for work in flat stopes of the future, the path of advance lies in perfecting hammer-drills or in changing piston-drill practice. [In the Lake Superior copper region the question has been definitely decided in favor of mounted hammer-drills.—Editor.] In one mine it has been stated that hammer-drills are not a success, because, among other things, the cost of sharpening and replacing hollow drill-steel is twice as much as with solid steel for piston-drills. If we increase nominal drilling speed too greatly we are sure to increase the cost of repairs, drill-steel, break-downs, and delays. It may be a mistake to endeavor to attain high efficiency by paying too much attention to one factor at the expense of others. In South Africa air-pipes supplying drills at working-faces are often too small."

The Electrical Theory of Flotation—II

By THOMAS M. BAINS, Jr.

The article in the MINING AND SCIENTIFIC PRESS of October 23, 1915, by Mr. O. C. Ralston, has brought out many points of interest. It seems to me, however, that the fundamental principles of flotation can best be studied with larger particles, thus avoiding the interesting, but also little understood 'colloid' chemistry. In gravity separation by uprising currents of water, Rittinger's formula $V=c\sqrt{D(S-L)}$ holds true for particles above a certain size, namely, about 0.2 mm. for quartz and 0.13 mm. in case of galena. Below these sizes, colloidal and other little-known phenomena become of importance and complicate the investigation. So it is with flotation.

In the laboratory, it is possible to use larger particles. The following experiments were conducted in the Case School of Applied Science on material sized through 20 and 30-mesh screens. The phenomena connected with preferential flotation furnish new evidence to strengthen the electrical theory.

The simplest experiment, demonstrating preferential flotation, may be performed as follows: Upon a 4-inch watch-glass, place a little galena, blende, and quartz, of 20 to 30-mesh size. Add dilute nitric acid and place the glass under a microscope. The acid attacks the galena, forming bubbles of H_2S gas that adhere to the galena. The particles of galena are electrified also, as can be seen by the actions of the particles. The blende and quartz are not attacked. If the ore had been finely pulverized and dilute nitric acid added, the bubbles of H_2S would have been sufficient to float the galena, leaving the blende and quartz at the bottom. However, with fine particles, some blende and quartz would have been entrapped, brought to the surface, and held there by surface tension. The bubbles are not sufficient to float the coarse galena, but by a vanning motion of the glass, the galena will collect, being brought and held together by the H_2S bubbles, forming a mat, which is lighter than quartz or blende and can, therefore, be panned off, leaving the blende and quartz. This experiment seems to show that the H_2S is charged oppositely to the galena.

If more concentrated nitric acid had been added to the ore, the blende would have been attacked and the process would have been reversed, the blende forming the mat while galena and quartz were left behind. If dilute sulphuric acid, one part of acid to four of water, had been used, then both the blende and galena would have been attacked and if the ore had been finely pulverized, no 'preferential' separation would have resulted, both galena and blende finding their way into the float concentrate. However, with coarse material, the blende is much more highly charged than the galena and if the watch-glass be tapped and the contents given a vanning motion, the blende will gather most of the H_2S bubbles and finally float, leaving galena and quartz behind. This shows that the electrification of minerals varies with different acids and also with different strengths of the same. This action of one mineral, 'robbing' the others of their bubbles, has not been utilized in practice, as yet, but there is no reason why 'preferential' separations could not be made on a large scale, utilizing this principle. Less air or gas would be necessary than in the present type of frothing-cells and a clean concentrate would be produced at once. A separation of blende, galena, pyrite, and quartz may be made as follows:

Add dilute sulphuric acid and pan off the blende; then add dilute nitric acid and pan off the galena; then add concentrated sulphuric or nitric acid, which attacks the pyrite so that it may be panned off.

Or the separation may be made with nitric acid alone, varying the strengths; with sulphuric acid, by use of the 'robbing' action described above or by use of hydrochloric and other reagents that attack one or another of the minerals more strongly than the others. If galena or blende and magnetite be treated with dilute sulphuric acid, the magnetite will not be acted upon by the acid, but some of the H_2S bubbles generated by the sulphide will attach themselves to the magnetite, provided the bubble is formed near the magnetite. This illustrates the fact that electrical conductors in a conducting liquid attract electrified bubbles. A slight jar, however, will displace these bubbles; or a piece of sulphide in close proximity will rob the magnetite of the bubble, magnetite being a poor conductor.

Referring to the article on page 668 of the MINING AND SCIENTIFIC PRESS of October 30, 1915, describing a patent for preferential flotation of blende, galena, and pyrite, the second paragraph reads: "The new process consists of treating ores in a medium (i.e. sulphuric acid and sodium sulphite) that wets the zinc sulphide and which does not wet the lead sulphide or pyrite." This phenomenon brings out nicely the part played in flotation by the "dielectric film." When thio-sulphates, sulphites, or bi-sulphites are acted upon by sulphuric acid, there is more to the phenomenon than formation of SO_2 gas. The following reactions take place when blende and galena are treated with sulphuric acid and sodium sulphide:

$$ZnS+PbS+2H_2SO_4=ZnSO_4+PbSO_4+2H_2S$$

$$*Na_2SO_3+H_2SO_4=Na_2SO_4+H_2O+SO_2$$

$$\dagger 2H_2S+SO_2=2H_2O+3S$$

This sulphur thus formed is in a very fine state and acts as a dielectric film about the galena, for which it has

*Newth's 'Inorganic Chemistry,' p. 417.

†*Ibid.*, p. 436.

a great attraction. Therefore, no frothing agent is needed in this case, as the dielectric film about the bubbles is formed by the sulphur similarly to the films of oil formed in the ordinary flotation processes. In the last paragraph of the above-mentioned article on 'Preferential Flotation,' the statement is made that "the procuring of the effect aimed at, is dependent upon the presence of a frothing agent, *only* when a reducing gas is *introduced* into the medium. It is not dependent on the presence of a frothing agent in the flotation medium, when a reducing gas is *generated* in the flotation medium by a reaction of a substance introduced into it." In other words, if sulphur or any other 'dielectric' is liberated in a very fine state, by a "reaction of a substance introduced," no frothing agent need be used.

This action may be nicely illustrated by taking 20 to 30-mesh galena and blende and treating them with dilute nitric acid on a watch-glass and observing the result under a microscope. The galena will gather all the H_2S bubbles, when vanned. Now if sulphuric acid is added and the watch-glass be tapped and the particles moved over one another, the H_2S bubbles on the galena will be robbed by the blende. Sulphur may be seen surrounding the bubbles, the reaction being as follows:

$$ZnS+PbS+2H_2SO_4=ZnSO_4+PbSO_4+2H_2S$$

$$(1)\ H_2S+H_2SO_4=SO_2+2H_2O+S$$

$$(2)\ 2H_2S+SO_2=2H_2O+3S$$

In (1), the sulphur is formed from the decomposition of H_2S; and would be charged oppositely to the sulphur formed by the decomposition of SO_2 gas. In (2), we have both negatively and positively charged sulphur particles.

The larger bubbles, with sulphur particles adhering to them, may burst on reaching the surface and their film of sulphur will spread over the water. If particles of mineral had been attracted to the bubble, then these particles would have remained attached to the sulphur film, even after disruption of the bubble, showing the electrification of the dielectric film. The same phenomenon occurs when the film is a liquid dielectric, like oil.

The laboratory tests with chemical reagents generating H_2S gas give the opposite results from the regular air-bubble flotation. The ordinary flotation method in practice is to add a little acid and frothing agent to the pulp. The sulphides are positively charged by friction, while the frothing agent and air are charged negatively. The oil surrounds the sulphides, but the film is so thin that the negatively-charged bubble is attracted by the positively-charged sulphide. If the film of oil is too thick, the attraction between the sulphide and bubble is too feeble, and flotation fails.

In the laboratory, H_2S is charged positively, but the sulphides are charged negatively by chemical action. So the bubble attaches itself to the electrified sulphide.

In preferential flotation of galena and blende, in practice, the ore is treated with H_2SO_4 and Na_2SO_3. Sulphur is liberated and the galena is coated with the particles of sulphur positively-charged, while the negatively-charged sulphur coats the gas bubbles. The negatively-charged air bubbles of the flotation machine attach themselves to the positively-charged sulphur coating the galena and repel the negatively-charged blende.

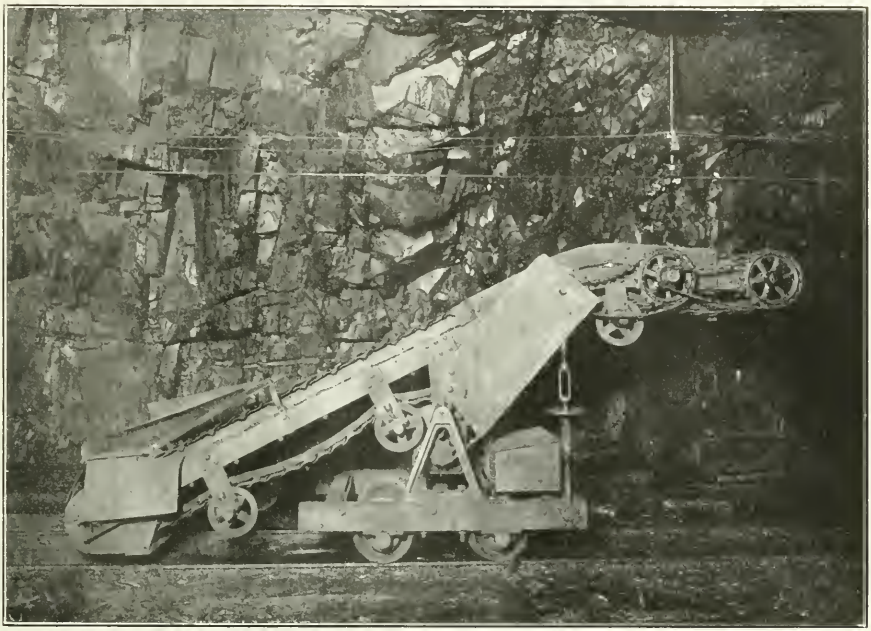
In the laboratory experiments, the H_2S bubbles are charged positively and are attracted to the negatively-charged blende and repelled by the positively-charged sulphur on the galena. In this case, the blende is floated. When H_2S is blown into the pulp in practice, no sulphur is formed—the H_2SO_4 solution being too weak for this reaction. Therefore, to make a persistent froth, a frothing agent must be added to the pulp.

In conclusion, it may be well to call attention to the fact that for laboratory experiments in preferential flotation, any one of the sulphides may be separated from the other sulphides, (*a*) by the use of some reagent that attacks this particular sulphide and not the others, (*b*) by the use of a reagent that attacks one sulphide more vigorously than the others; in this case, the vanning motion allows the sulphide more highly charged to gather up the bubbles from the sulphides less highly charged, and if sufficient bubbles are collected, the mass of bubbles and sulphide will float. If not sufficiently buoyed, the mass remains submerged, but it is lighter than the other sulphides or gangue minerals and can be panned off or separated by hydraulic classification.

The second point of interest is the formation of a frothing agent, within the pulp, when reactions take place that liberate dielectric substances in a very fine state, electrically charged.

The third point is that laboratory experiments may not work out in practice, due to failure to understand the nature of the electrical charges of the bubbles, dielectrics, and particles of ore. A little stronger reagent or a different way of frictionally electrifying the bubbles and pulp, or too thick a film of dielectric or frothing agent causes the attraction to cease or change. It is no wonder that great difficulty has been experienced in the practical application of flotation to ores, when such delicate electric forces have to be considered.

TUNGSTEN, it is asserted, can no longer be considered a rare metal, since as far back as 1913, the tungsten output of the world exceeded in weight that of the combined production of mercury, gold, bismuth, and cadmium. In 1913, the United States produced 1397 metric tons of tungsten ore (60% WO_3); as compared to 1732 tons produced in Burma; 1403 tons in Bolivia, Peru, and Argentina; 1380 tons in Portugal, and 752 tons in Australia (principally Queensland). In the United States, Boulder county, Colorado, is the largest producer, ferberite or iron tungstate being the principal ore; the Atolia district in the Mohave desert of California is the largest scheelite (tungstate of lime) producer in the world; hübnerite (tungstate of manganese) deposits are worked in Arizona, Idaho, and Nevada; some wolframite (tungstate of iron and manganese) discoveries have been made in South Dakota and New Mexico. The Conger mine, in Boulder county, Colorado, is said to be the greatest mine of its kind in the world, having produced nearly $1,500,000 of tungsten.



PORTABLE ROCK-LOADER MADE AT THE SHOPS OF THE CLEVELAND-CLIFFS IRON COMPANY.

Fast Driving in a Michigan Iron Mine

By J. E. HAYDEN

*The Morris-Lloyd mine of the Cleveland-Cliffs Iron Co., is situated at North Lake, four miles west of the City of Ishpeming. At a distance of 3000 ft. east of the Lloyd shaft, an orebody was discovered by diamond-drilling from surface. In the fall of 1914 it was decided to open up this orebody by driving from the Lloyd shaft on the 600-ft. level. A 9 by 10-ft. heading, without timber, was driven due east from a point 350 ft. south of the shaft in the slate foot-wall, which strikes almost due east and west, and dips at an angle of 85° south.

The drift was started on September 1, 1914, and completed on June 17, 1915, a distance of 2960 ft. having been driven in 240 working days. The record month was May, 1915, when 406 ft. of drift was done in 26 working days. During this month the best day's progress was 19 ft. 9 in. (due to a partly missed-cut on the previous shift); the poorest day's was 12 ft. 9 in., the average daily progress being 15 ft. 8 in. The average monthly progress throughout the 9½ months was 311 ft. 6 in., the average daily progress being 12 ft. 4 inches.

The rocks traversed were slate, graywacke, and quartzite. The work was done on two 8-hour shifts; 4 miners, and, for the greater part of the time, 6 shovelers constituted the crew. The shovelers alternated, one gang of 3 filled a car, while 3 rested. Two No. 18 Ingersoll-Leyner drills were used throughout the work, except for the first 100 ft., when two 3¼-in. piston machines were used. Electric-motor haulage was used in 2300 ft. of the drift, and hand-tramming in the first 600 ft. Permanent track on a 0.75% grade was laid and kept to the face. The trolley-wire was kept within 150 ft. of the face, the shovelers tramming the car this distance to the motor. At intervals of 300 ft. along the drift, sidings were cut to hold three motor-cars. Throughout the work, 80% nitro-glycerine dynamite was employed. The fact that the drift paralleled the slips made it necessary to use a strong explosive to insure breaking the cut, as the ground was extremely tight. This also eliminated large chunks and threw the broken rock a considerable distance from the face, enabling the miners to rig-up quickly for drilling the next cut.

As the ground varied considerably, it was necessary to vary the cut. Fig. 1 and 2 represent the two cuts used. Fig. 1 was the cut commonly adopted for driving in slate, and Fig. 2 when in quartzite and graywacke. In Fig. 1, holes 1 to 11 were drilled from the bar in one

*Abstract of paper presented at 1915 meeting of Lake Superior Mining Institute.

position, and fired in one blast. To complete the square all 14 holes were fired on the second blast. It was found that good results were obtained only when holes 5-6 and 9-10 intersected at their respective ends. This point was carefully watched, the shift-boss testing these holes before each blast. For the extremely hard ground, such as the quartzite, the cut was made as in Fig. 2, the top 15 holes being fired in the first blast, and all 19 holes to complete the second cut and square. The two relief-cut holes (see Fig. 2), were drilled to meet at a depth of 3 ft. For the moderately hard ground, such as the graywacke, two easing holes were drilled as in Fig. 2, instead of the 3-ft. relief cut.

Fig. 3 shows the cycle of operation to complete the square, *A* representing the portion removed in the first blast, *B* that portion removed in the second blast. Each shift blasted twice, completing the cut, leaving the drift squared. During the entire progress of the work, there

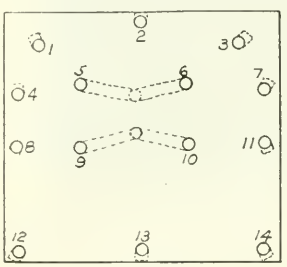


Fig. 1.

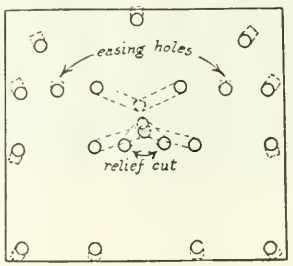


Fig. 2.

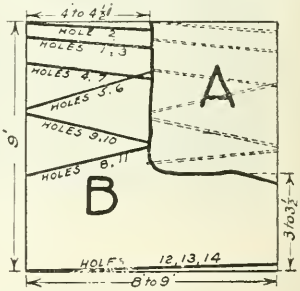


Fig. 3.

was but one slight injury, that being caused by a piece of rock hitting a miner's hand while barring down loose ground from the back.

Three-ton saddle-back motor-cars were used; These had a height of 5 ft. 6 in. above the rail in the clear, which necessitated much shoveling. This difficulty was overcome by the installation of a portable loader during the latter half of April. This loader consisted of an inclined steel-apron conveyor-belt with 2¼-in. angle-irons placed 15 in. centre to centre, mounted on a roller-bearing truck, operated by a 5-hp. series motor taking current from the underground-haulage wire. The loader was arranged so that the angle of the incline could be reduced, allowing it to pass under the trolley-wire. The men shoveled into a hopper at the lower end of the belt, the rock being conveyed up the incline and dumped into the motor-car. A small part of the rock could be picked down from the pile into the hopper. Three men shoveled, while one trimmed the car. The work was hastened after the loader went into commission, as it became possible to handle more rock. Within a week the output was increased 25%, and later on it often reached 30%. The whole cycle of operations was completed earlier on the 8-hour shift, giving more time for drilling, consequently deeper cuts were tried, with extra holes, to insure breaking.

At a distance of 1220 ft. from the shaft, a fan-station artificial ventilation was used in the 1220 ft. of drift up to the fan-station. As most of this work was done during cold weather when the shaft was strongly up-cast, the blowing of air in the breast was sufficient to clear the drift in 30 minutes.

The following is a detailed cost of the 2960 ft. of drift:

	Labor.	Supplies.	Total.	Cost per ft.
Miners	$ 8,430.27	$ 1,587.73	$10,018.00	$ 3.384
Shoveling	8,169.03	.....	8,169.03	2.760
Tramming	1,117.92	498.39	1,616.31	0.546
Explosives	.....	6,889.86	6,889.86	2.325
Air	.....	720.00	720.00	0.244
Shop-expense	460.00	230.00	690.00	0.233
Machine-repairs	135.50	1,196.27	1,331.77	0.451
Air and water hose	.....	75.00	75.00	0.025
Carbide	.....	95.00	95.00	0.032
Total cost	$18,312.72	$11,292.25	$29,604.97	$10.000
Per foot	6.18	3.82		

The value of mineral production of the United States in 1914, according to the U. S. Geological Survey, was $2,114,946,024, being exceeded only by that of two years —1913 and 1912. The metallic products in 1914 were valued at $691,000,343, and the non-metallic products at $1,423,395,681. The bound volumes (2), of 'Mineral Resources of the United States' for 1914 will soon be ready for distribution. They deal with metals and non-metals respectively.

Plant-Construction Costs in Korea

By A. E. DRUCKER

Construction costs are of great value for particular districts; they vary largely in different parts of the world, depending more or less on labor and transportation. It is customary to add from 10 to 20% of the estimated cost as a safety factor, depending upon the engineer's knowledge of the district in which the plant is to be erected.

Herewith I give an itemized account of the actual cost of a re-treatment plant in Korea. It was designed to retreat an old cyanide tailing-dump containing about one-half sand and the remaining half sulphides of iron, zinc, and lead. This mixed product was caught originally on Union vanners in a 40-stamp mill and cyanided for 16 days in leaching-vats. The method of treatment for this old oxidized dump was screening, washing, and concentrating on Wilfley tables. The clean sulphide product, containing 80 to 90% of the original gold-value, received a preliminary air-agitation with lime and water. It was then de-watered, tube-milled in cyanide solution, and received a final cyanide treatment in Callow decantation cones, Pachuca tanks, and a Dehne filter-press.

KUK SAN DONG MILL, KOREA.

The plant consisted of one stock-solution tank 15 by 10 ft. deep, one water-supply tank 15 by 15 by 10, weigh-bridge, storage-bins 10 by 20 by 10 and 20 by 20 by 10, one tube-mill 4 by 16 ft., one 3-in. sand-pump, one screening mill 5 by 3 ft., two double-cone classifiers, six Callow cones, four Pachuca tanks 8 ft. diam. by 30 ft. high, eight Wilfley tables, two sand-filter tanks, each 10 by 6 ft., four (6-comp.) zinc-boxes, two solution-sump tanks 15 by 10 ft., one monteju, one 24-frame Dehne press, two centrifugal solution pumps, one steam-compressor, one belt-driven compressor, two vacuum-pumps, one Pachuca lime agitation-tank with concentrate-collecting boxes and bucket-elevator.

Steam was used to operate the plant. There were also the necessary stone retaining-walls and concrete foundations. The building was a wooden structure covered with corrugated sheet-roofing. All cyanide tanks were of steel plate.

The cost of construction is summed up as follows:

DUMP RE-TREATMENT PLANT CONSTRUCTION

Salaries	$ 2,276.60
Board	219.99
Supplies	24,524.32
Pay-roll	3,399.86
Shops	5,543.87
Stable	90.00
Total	$36,054.64
Expenses in May (testing plants, etc.)	3,282.00
Grand total	$39,336.65

This plant had a maximum capacity of 60 tons per 24 hours on dump material averaging 50% of sulphides. The total cost of construction was $39,336, being at the rate of $655 per ton of capacity per 24 hours.

TARACOL STAMP-MILL (original). Eighty 1050-lb. stamps, four Blake crushers, thirty-two 6-ft. Frue vanners, 16 copper amalgamating-plates, and steam-power plant. Capacity of plant, 360 to 365 tons per 24 hours, with 25-mesh battery-screens and low discharge. Original cost of plant was approximately $128,000. Now operated by electric power.

TABOWIE STAMP-MILL (new addition. Forty 1050-lb. stamps, two Blake crushers, sixteen 6-ft. Frue vanners, eight copper plates, and steam power-plant. Capacity of plant, 170 to 175 tons per 24 hours, with 25-mesh screens and low discharge. Original cost of plant was approximately $66,000. Now operated by electric power.

CANDLESTICK STAMP-MILL. Ten 1050-lb. stamps, one Blake crusher, two copper plates, three cone-thickeners, four mechanical agitators 15 ft. diam. by 10 ft. deep, four sand filter-tanks 12 by 6 ft., six zinc-boxes, three sump solution-tanks, pumps, and steam-power plant. All cyanide tanks are of wood. Capacity of plant 25 tons. Original cost $27,000, approximately.

THE ADVANTAGES OF CANADA'S BANKS and banking systems, with branches in nearly every city, lie in the facility with which the money of the country can be shifted to the district where it is needed, for harvesting, logging, or mining, varying with the season. Money is raised in the Eastern cities where interest is low, and forwarded to new Western towns where it is most needed. It is stated that in the early days at Porcupine, when the railroad was 35 miles away, there promptly sprang up branches of the great Canadian banks in scrubby log-cabins, in which business was conducted as capably and satisfactorily as though the permanence of the camp was a foregone conclusion.

Precipitation With Zinc-Thread

By JAY A. CARPENTER*

The purpose of this article is to give data on precipitation with zinc-thread at a Tonopah mill and to show that this method, although second in efficiency to the use of zinc-dust, gives excellent results when operated under favorable conditions. There seems to be a tendency in articles published in the technical press to extoll the virtues of any new method, to the disadvantage of the old one. At the time of the growing popularity of the Pachuca agitator it would have been heresy to publish the fact that they filled gradually with solidified pulp, and it was not until their popularity was on the wane that this was asserted in print. Likewise, zinc thread or shaving, once so popular because it won in competition with electric precipitation, is now only mentioned for its disadvantages. Even such an excellent paper as that of G. H. Clevenger on precipitation methods (presented at the International Engineering Congress) contains the inference that zinc-thread is greatly outclassed by zinc-dust. It is true that zinc-thread precipitation has its bugbear, namely, the white precipitate, but it is also true that with precipitating-presses, a bad cask of zinc-dust, or some other reason safely locked in the iron press, may cause the metallurgist just as much worry. Occasionally muddy solutions give trouble in zinc-boxes, but they play havoc in zinc-presses. Zinc-boxes may be subject to petty theft, but the bulk of the precipitate is not in a frame waiting the hold-up man. It has been said that, "comparative costs of zinc-dust and zinc-shaving show considerable advantage in favor of zinc-dust," but special mention should also be made of the fact that by the time the mill is provided with the heavy metal presses necessary to clarify and precipitate the solution with zinc-dust, the investment is so greatly in excess of the simple zinc-boxes that the saving made with the dust must extend over a long period to balance the greater outlay of capital. When the metallurgist considers the large number of mills that never pay back the capital invested, this point should cause him to consider the less efficient but cheaper methods, to see if their efficiency cannot be improved sufficiently to warrant installation.

In designing the West End mill in 1911, from data on silver cyanide-plants, I decided that five tons of solution should be precipitated for each ton of ore treated, or 600 tons for the 120-ton mill-capacity, and that this 600 tons required 0.75 cu. ft. of zinc-shaving for each ton, or 450 cu. ft. in all. Six redwood boxes were built, each with six compartments 30 by 30 by 24 in. deep. Below the screen of each compartment was a double hopper, which discharged through an 1½-in. plug-cock into a gravity system of launders leading to the precipitate vacuum-tanks. At the end of the first three months' operation the consumption was 1.7 oz. troy of zinc for each troy ounce of refined gold and silver recovered. About four tons of solution had been precipitated per ton of ore. This solution was made up as a 6 lb. KCN solution, with 1 lb. protective alkali, expressed as NaOH. The cyanide titration is made for total cyanide without any additional alkali, and we titrate for the protective alkali without the addition of ferro-cyanide. This high zinc consumption was probably due to the fresh strong solution, but it resulted in a local hunt for comparative data, which were recorded as shown herewith:

	Montana. 1908.	Extension. 1911.	Desert. 1910-'11.	Belmont. 1910-'11.	West End. 1911.
Zinc used per oz. of bullion, lb.	0.108	0.065	0.084	0.09	0.11
Zinc per ton solution p'p'ted, cu. ft. Dust		1.57	0.81	0.75	0.87
Solution p'p'ted per ton of ore, tons	2.75	4.0	5.5	4.5	4.0
Bullion per ton of ore, oz.	8.5	17.0	21.0	20.0	15.5
Troy oz. zinc for troy oz. Au and Ag in bullion	1.67	0.945	1.22	1.31	1.7

Believing that the high consumption of zinc at the West End was partly due to buying zinc already cut (about a 1/600-in. shaving), a zinc-lathe was installed, and fresh zinc was cut as needed, about 1/300 in. thick. Results in 1912 were much better, there being a zinc consumption of 1.18 unit-weights of zinc for each unit-weight of refined bullion, but with only about 0.8 cu. ft. zinc per ton of pregnant solution, averaging 4 oz. in silver and 0.04 oz. gold; the precipitated solution still contained 0.10 oz. to 0.30 oz. silver. This precipitated solution, used as filter-cake barren-wash, resulted in high soluble losses.

In 1913, two 120-cu. ft. iron zinc-boxes, each having seven compartments 36 by 24, and 32 in. deep, were added; one to precipitate solution to a low value for filter-cake wash solution, the other to precipitate the wash-water circuit on the filter. The quantity of zinc-shaving in this second box, and the tonnage of wash-water precipitated by it, are not considered in the following table, but its zinc consumption and the bullion produced by it are included. This box precipitates about 2000 tons per month of wash-water, drawn through the filter-cake by a vacuum-pump and carrying about 0.4 oz. silver, giving a precipitated solution containing a trace to 0.02 oz. of silver. These boxes resulted in impoverishing the precipitated solutions used as filter-washes, and allowed the wooden boxes to be used for incomplete precipitation. An increase in ore tonnage nearly offset the increase in zinc-box capacity. However, for the year 1913 the consumption of zinc was 1.48 unit-weights of zinc for each unit-weight of refined bullion. This was due to an increase in alkalinity of the pregnant solution, and to a

*Mill superintendent, West End Con. Mining Co., Tonopah, Nevada.

policy of keeping the short zinc at a minimum quantity.

In 1914, with an increase in the reduction-plant to treat 200 tons per day, two more iron zinc-boxes were added to the complete precipitation circuit, resulting in an increase in area of zinc per ton precipitated. Less solution was precipitated per ton of ore, more 'shorts' were allowed to accumulate in the boxes, and a pregnant solution of higher value somewhat lower in cyanide and alkali was precipitated, the combination resulting in a decrease in zinc consumption for 1914 to 1.27 units for each unit of refined bullion.

The mill-solution that had been carried at over 6 lb. KCN in 1912, was dropped to 5.3 lb. in 1914 on the same grade of ore, and in January to April 1915 it had been lowered to 4.4 lb. on a better grade of ore. In May it was reduced to 3 lb. on the same grade of ore. The protective alkali that had been carried above 1.0 lb. protective NaOH up to 1915, was lowered to 0.7 lb. The result for the month was surprising, as the zinc consumption was only 0.66 unit zinc for each unit-weight of refined bullion, or expressed in ounces, 0.66 oz. troy zinc for each ounce gold and silver recovered in the bullion. Results during the following months were watched with great interest to see if May was exceptional, or if a method of saving zinc had really been proved. For six months now this low record has been maintained. In spite of a variation in the ore from $13.50 to $19.60 per ton, the zinc has varied likewise, resulting in a consistent consumption of zinc for the bullion recovered. The monthly mill-reports show the following consumption of zinc in pounds per ounce of refined bullion extracted: May, 0.044; June, 0.05; July, 0.045; August, 0.044; September, 0.044; and October, 0.045 lb. The average is 0.0453 lb., which is equal to 0.66 oz. troy zinc for each ounce refined bullion. A summary of the precipitation record described above is given in the following table:

PRECIPITATION RECORD AT WEST END MILL

	1911.	1912.	1913.	1914.	Jan.-Apr., inc., 1915.	May-Oct., inc., 1915.
Tons of ore per day	120	123*	140*	179*	155	158
Bullion recovered per ton, in oz. fine	15.5	15.4	17.9	15.3	19.1	23.6
Solution precipitated per ton of ore, tons	4.0	4.1	4.0	3.3	3.5	3.5
Bullion precipitated per ton of solution, in oz. fine	3.9	3.8	4.5	4.7	5.7	6.4†
Solution precipitated, incomplete, in tons	..	...	490	380	341	352
Solution precipitated, complete, in tons	480	500	70	210	202	202
Zinc per ton of solution p'p'ted, incomplete, in cu. ft.	..	...	0.85	1.10	1.23	1.19
Zinc per ton of solution p'p'ted, complete, in cu. ft.	0.90	0.84	1.70	1.70	1.70	1.70
Zinc per ton of solution p'p'ted, part and complete average, in cu. ft.	0.90	0.84	0.96	1.32	1.44	1.41
Total zinc, cu. ft.	420	420	540	780	780	780
Zinc used per ton of ore, lb.	1.70	1.25	1.80	1.34	1.46	1.01
Zinc per oz. of bullion, oz. troy	1.70	1.18	1.46	1.27	1.21	0.66

*Concentration throughout 1913, and about one-half of 1912 and 1914, removed other metal from the ore, in addition to that shown as bullion.

†The ratio of gold to silver is about the same as in the ore, namely 1:100, which, estimating gold at $20 per oz., and silver at 50c. per oz., gives a value of 70c. per oz., or for 6.8 oz. a value of $4.76.

In 1915, from January to April, inclusive, the tonnages of ore and pregnant solution were both considerably less than in 1914, resulting in a marked increase in cubic feet of zinc per ton of solution precipitated, yet with a decrease in the cyanide and alkali strength of the pregnant solution, made with the idea of saving cyanide, there was a distinct drop in zinc consumption to 1.21 units of zinc to each unit-weight of refined bullion. With the price of sheet-zinc soaring to an almost prohibitive point, it was decided to cut the cyanide and alkali strength of the pregnant solution as low as was consistent with good extraction, the drop in cyanide strength to be balanced by keeping the mill-solution fresher, and therefore more active.

The most important conclusions to be drawn from these results is that the high cyanide and alkali strength of the pregnant solution is responsible for the high zinc consumption in silver cyanide-plants. Another point of importance is that a greater volume of zinc-box capacity for a given tonnage of solution does not increase zinc consumption, but rather tends to decrease it by allowing ample space for the care of the short zinc.

Zinc consumption in 1915, as shown in the table, where a small quantity of rich solution is precipitated per ton of ore, is low compared with mills precipitating large volumes of solution of lower grade. In a recent description of a silver mill, 'Cyanide Practice of Churchill Milling Co., Wonder, Nevada,' A. I. M. E., San Francisco meeting, Sept. 1915, treating an ore of about the same gold and silver-content, but using a 4.6 lb. KCN and 1.6 protective CaO solution, and precipitating 6 tons of solution per ton of ore, which was over 2 tons per cu. ft. of zinc-shaving, the zinc consumption was given as 1 lb. for each 10.19 oz. bullion. This represents about 1.5 oz. troy zinc for each ounce of refined bullion, which is close to the results obtained in the Tonopah mills using high cyanide and alkali solutions, and precipitating on zinc-thread a large amount of solution per ton of ore. It would probably hold true also in continuous-decantation plants, where the tendency is to precipitate a maximum tonnage of solution.

Work on the zinc-boxes at the West End mill varies but little from standard practice. The boxes are cleaned twice per month; all precipitate passing a 20-mesh screen is melted, the remainder is returned to the first two compartments of all the boxes as short zinc, where it is mixed with a little of the zinc moved up from the third and fourth compartments. The last compartments are left empty, to be filled when the value of the precipitated solution increases before the next clean-up. Between clean-ups the short zinc is occasionally shaken by catching a hook in the screen below it. Channeling in all compartments is prevented as much as possible. If too much slime has reached the boxes, the zinc may be washed, moved up, and re-packed. The strips of zinc left from cutting the sheet-zinc on the lathe are divided into small pieces, and mixed with the short zinc, serving for a time the purpose of holding the shorts apart.

The rich solution passing through the short zinc in all of the first two compartments loses much of its metal content to them, thus protecting the long zinc, and at the

same time consuming much of the short zinc. In 1913, on account of limited zinc-box capacity, we tried the rather foolish plan of melting shorts, and later of tube-milling them in pregnant solution, but the net result was a useless consumption of zinc with as much shorts as ever, due to placing long zinc in the first and second compartments, where it was quickly cut into shorts by the rich solution. The second table shows this period to be one of high zinc consumption.

The low consumption of zinc cannot be credited, even in part, to clean solutions for precipitation, as no means of clarifying is used except the inefficient one of excelsior, while over three-fifths of the solution is not filtered, but is directly decanted from under the foamy tops of Dorr thickeners and Trent agitators. Trouble from muddy solution in the zinc-boxes is rare, but in treating custom ores, the settling varies so greatly that cloudy solutions occur often. A couple of melts have been prolonged half as long again over the usual time for the bullion produced, due to fine slime in the precipitate, yet the zinc consumption is not materially affected. The most pronounced effect is in the increased value in the precipitated solutions.

The average value of the precipitated solution from the wooden or partial precipitation boxes is 0.20 oz. silver and 0.002 oz. gold, or 14c. per ton; the completely precipitated solution is 0.06 oz. silver, with a trace of gold, and except for two days preceding and during the clean-up, it will vary in total values from 1 to 2c. The same pregnant solution feeds both sets of boxes, and has an approximate value of $4.76.

The zinc in the last compartments is often bright red, from a copper coating; the average content of copper in the ore, however, is almost negligible. The copper in the precipitate averages 3.33%, in the slag, 1.2%, and in the bullion, 4.1%. The use of the weaker cyanide solution results in less copper being extracted from the ore. The precipitate averages 70% gold and silver; it contains less than 7% zinc, giving 10% zinc in the slag, and 1.9% in the bullion. This zinc in the precipitate produces almost no visible zinc fume, and there would be no object in attempting its recovery.

The figure of 0.66 oz. troy zinc per ounce of gold and silver is very close to the theoretical, since the precipitation of silver by zinc is presumably 0.6 weight of zinc for one part of silver. This allows 10% excess for mechanical loss of zinc and for copper precipitation, which seems too close a margin. However, since so many separate months check this figure, and the store-house record of 500-lb. rolls is easily counted, I believe it is correct. It is to be noted that the reaction:

$$(1)\quad KAg(CN)_2 + 2KCN + Zn + H_2O = K_2Zn(CN)_4 + Ag + H + KOH,$$

in which only one part of silver is precipitated by 0.6 part zinc is prefaced in Clennell's 'Cyanide Handbook' by the statement that this reaction probably represents the entire effect of precipitation correctly. In this equation the bivalent zinc does not replace two of the univalent silver, as would be the case with a direct replacement of the silver as follows:

$$(2)\quad 2KAg(CN)_2 + Zn = 2Ag + K_2Zn(CN)_4$$

In this case, one of silver would be precipitated by 0.3 part zinc. However, we know that both hydrogen and an alkali are formed during precipitation, which can be explained by the equation:

$$(3)\quad Zn + 4KCN + H_2O = K_2Zn(CN)_4 + 2KOH + H$$

The combined reactions of (2) and (3) give (1); however, this reaction (1) is only advanced as an approximation, and with solutions rich in silver and low in cyanide, it may be possible that reaction (2) is more pronounced, giving greater efficiency for zinc as a precipitant that reaction (1) indicates.

The lowest published figure on zinc-dust is that given by A. H. Jones in the August Bulletin of the A. I. M. E., for the new Belmont mill at Tonopah, a consumption of 0.78 oz. troy per ounce gold and silver recovered, which is considerably lower than the figures given by Mr. Clevenger for a large Mexican mill using 1.1 parts on the complete circuit, and 0.74 part for the incomplete circuit. Since zinc-dust is much more impure than sheet-zinc, and as the figures on dust were based probably on precipitating solutions high in cyanide and alkali, these zinc-dust figures of consumption are very low.

In 1913 the MacNamara mill at Tonopah, precipitating with zinc-thread and using solutions low in cyanide and alkali, recovered 18.75 oz. bullion for 1 lb. of zinc-shaving, or about 0.83 oz. troy zinc per ounce gold and silver. The Tonopah Extension,† when using a low cyanide and alkali solution, recorded one ounce of bullion for 0.06 lb. zinc, which is about 0.93 oz. troy zinc per ounce of bullion. Both plants melted a certain amount of short zinc in order to keep enough zinc in the boxes to get 1 to 3c. precipitated solutions, as they had but one circuit, and both purchased their zinc in the form of zinc-shaving. Both plants precipitated a low quantity of high-grade solution, low in cyanide and alkali. At the West End, having the advantage of their excellent work, with the additional advantage of cutting our own zinc, and having an incomplete as well as complete circuit, we were able to improve upon their results. Undoubtedly, if the figures were made known, many other silver plants using zinc-thread would be found to have closely approached the low consumption of these Tonopah plants.

Often a zeal to lower costs in one department results in higher costs in other departments. The question would arise if the saving in zinc was made at an additional cost for cyanide, or at a loss in extraction. The ore during the six months, May to October inclusive, was worth $16.66 per ton. The consumption of cyanide was 60.8c. per ton of ore, this item being expressed in money due to the use of 100, 120, and 129% cyanide at different times in the last four years. This amounts to about 2.6 lb. of 129% cyanide at 23½c. per pound, which is as low a cost for cyanide as in 1912, when an ore of equal grade was treated. At that time about 13% of the values was removed by concentration, and a 6-lb. KCN and 1-lb. protective NaOH solution was used in the mill. It is the

†*Eng. and Min. Jour.*, Dec. 2, 1911.

same cost for cyanide as given in the annual report of the new Belmont mill for 1914, on the same grade of ore, where 11.5% of the value was recovered by concentration. The Belmont made a gross extraction of 93%, which, after deducting marketing costs and metallic deductions on concentrate and bullion, netted 90%. Extraction at the West End in 1915 has been better than with the higher before the lower cyanide strength, being 92.5%, with a marketing cost of 1.7% for bullion, giving a net extraction of 90.8%. In 1913, the Belmont mill, on a $21.08 ore, made the high gross extraction of 94.45% with a marketing cost of 2.56%, giving 91.9% net. These figures are given for example only, of extraction, marketing costs, and total recoveries, and cannot be directly compared, as ores from the different mines vary enough to give different results under similar conditions. However, the figures given for the West End can be taken as those of an average Tonopah ore, since the mill has treated ores from the West End, Halifax, Merger, Midway, North Star, and Montana mines during 1915.

It is evident that the saving of 50% in the zinc consumption per oz. of fine bullion was obtained without greater cost for cyanide, and with an increased extraction. The latter was because of the mill solutions carrying less impurities, and only 0.03% zinc. This saving was made during the time sheet-zinc reached the high figure of 28c. per lb., f.o.b., Peru, Illinois. It is now at 19c., which is over twice the average price of 1914. At the present time the study of zinc consumption in cyaniding is a profitable field.

Accidents at Metallurgical Plants

In Technical Paper 124 of the U. S. Bureau of Mines, compiled by Albert H. Fay, the above is discussed for the first time by the Bureau. It covers the years 1913 and 1914.

During these two years 119 men were killed, 2285 seriously injured, and 11,046 slightly injured at smelters and mills, representing fatality and injury rates of 1.55, 29.67, and 143.44, respectively, per 1000 men employed. The report includes the returns of 79 smelting-plants in 1913, and 94 in 1914, including copper, lead, and zinc, and quicksilver smelters, as well as refineries. The iron blast-furnaces are not included in the figures given herein. The number of ore-dressing plants reporting in 1913 was 311, and in 1914, 484. These represent concentrating plants of copper, lead, and zinc ores, stamp-mills, cyanide-plants, and iron-ore washers.

A request for reports of accidents at metallurgical plants was sent out late in 1914 for the year 1913, and there were a number of companies that did not render reports, the request being the first made by the Bureau for reports of accidents at such plants. A larger number of operators reported for the year 1914 than did for 1913, as indicated above. The total number of men reported employed in the metallurgical plants, both smelters and ore-dressing plants, was 35,549 in 1913 and 41,461 in 1914.

Slight increases in fatality or accident rates in 1914, as compared with 1913, may be apparent rather than real, because of more detailed reports having been made for 1914.

The data given were voluntarily supplied by the officials and managers of the metallurgical companies at the request of the Bureau, there being no law compelling such companies to render a report.

In the ore-dressing plants, machinery was responsible for 25.6% of all fatalities, 28.9% of the serious injuries, and 16.5% of the slight injuries. Similar figures for smelting-plants are much smaller, for the reason that there is more machinery in use in ore-dressing plants than at smelters, and the men are usually in closer contact with the machinery, as, for example, at jigs, tables, stamps, rolls, and crushers. There are many revolving shafts, a large number of which have projecting keys, moving belts, wheels, and cams within the reach of the operator. The machinery at smelting-plants is usually confined to the power-house, where the blowers, engines, and dynamos are placed, and to overhead cranes, most of which are out of reach of the regular employees.

The percentage of accidents due to any one cause is given in the following table:

Cause of accident.	Ore-dressing plants.			Smelting plants.		
	Killed.	Seriously injured.	Slightly injured.	Killed.	Seriously injured.	Slightly injured.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Haulage	12.8	9.6	6.9	25.0	14.0	9.7
Machinery	25.6	28.9	16.5	18.7	9.0	5.7
Falls of persons	15.4	16.0	12.4	20.0	13.8	9.5
Suffocation in ore-bins	7.7	.....	.1	3.7	.2	.1
Flying or falling objects	15.4	16.0	23.8	5.0	14.7	17.1
Electricity	7.7	1.7	1.4	5.0	.6	1.2
Hand tools	.....	5.3	10.5	.....	6.9	10.9
Nails, splinters, etc.	.....	1.1	5.1	.....	.3	2.1
Burns	.....	1.0	1.0	11.3	26.7	20.6
Other causes	15.4	20.4	22.3	11.3	13.8	23.1

The percentage of accidents due to falls of persons and flying and falling objects is 15.4% for each in ore-dressing plants, whereas at the smelters the fatalities due to falls of persons represent 20% of the total, and those due to flying or falling objects represent 5%.

Haulage systems cause 25% of the fatalities at smelting-plants, and about half this at ore-dressing plants. The difference is largely due to the type of material handled and to the larger number of cars in operation around smelter yards than at ore-dressing plants. In many ore-dressing plants the ore is brought to the bins in railroad-cars or aerial-trams, and often there is no other haulage-system in connection with the plants, the tailing usually being disposed of by launders or flumes, whereas at smelting-plants the molten slag is usually handled in slag-cars and the bullion on trucks.

At smelting-plants burns from hot metal, slag, etc., claim the largest percentage of serious and slight injuries, and 11.3% of the fatalities.

Disposal of Flotation Residue

By W. SHELLSHEAR

*Introduction. There are many methods of handling sand and slime from metallurgical operations, but in this article the draining and conveying of waste products from flotation processes will be specially dealt with, the methods given being those in use at the leading flotation plants in Australia.

Draining and Dewatering. It is generally advisable to thoroughly dewater the residue from flotation treatment in order to form a closed circuit of liquor. This maintains constant conditions throughout the plant and avoids waste of oil, which would be carried away by the solution with the tailing. The methods that may be used for this purpose are:

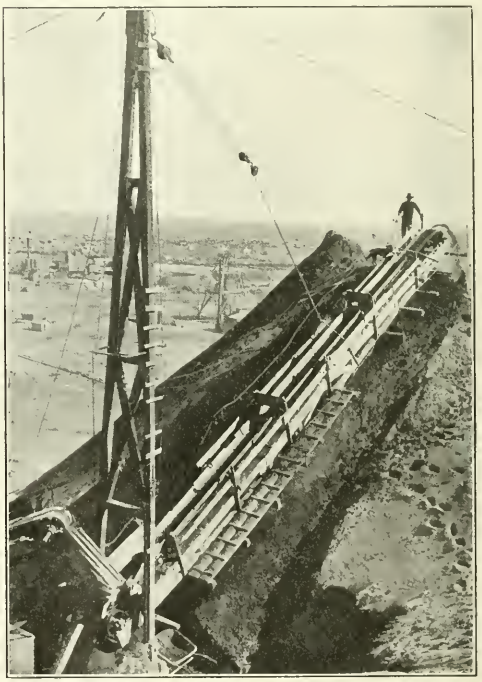
(a) Filtering in vats; (b) combination of a submerged draining-belt and Dorr thickeners; (c) combination of Caldecott diaphragm-cones, draining-belt, and Dorr thickeners, and (d) combination of Dorr classifiers and Dorr thickeners.

Filtering in Vats. In this system, shown in Fig. 1, the pulp from flotation is run direct into vats. These are usually 15 ft. diam., their depth varying from 10 to 20 ft. In the centre of each, and before filling, a tube or pipe, 15-in. diam., that fits over the circular discharge-hole, is inserted. When the vat is ready for emptying, this tube is lifted out, a large proportion of the tailing falling through the centre hole onto a conveyor underneath. The remainder is afterward shoveled upon the same conveyor.

A wooden frame, not shown in the sketch, is erected above the vat to support the lifting-device, a screw-block being used to raise the pipe to the desired height. This operation is afterward carried out by an ordinary block and tackle. The vat may be made of wood or iron, and the height to which it may be constructed is controlled by local conditions, such as the design of the plant, and the nature and fineness of the material to be filtered. It is, however, apparent that the greater the height that can be economically employed, the less the labor required, as a proportionately large amount drops through the centre of the vat without shoveling. This would tend to make the inner tube too long to be handled conveniently, but the difficulty has been overcome by making the tube in sections, each of which is lifted in its turn from the top as emptying proceeds.

The time of filtering is arranged according to the number of vats employed, but it is the usual practice to run the pulp through a number in series, so that the slime settles from the solution. Thus, if six vats are in use, one may be draining and another emptying, while the remainder would be used for the pulp flowing, in series, through them. The filtered water is carried off by a number of pipes at the bottom of each vat. Under certain conditions a suction-pump is connected to these pipes to assist the filtering, but this is not the usual practice. As a filtering medium, cocoa-nut matting is used generally.

After a vat has been emptied, the tube is dropped into



BOOM DISTRIBUTER AT KALGOORLIE, WESTERN AUSTRALIA, 150 FT. ABOVE THE GROUND. BELT-DRIVEN WITHOUT GEAR AT 900 FT. PER MINUTE BY SLOW-SPEED MOTOR CONTROLLED FROM PLANT BELOW. CAN BE MOVED WHILE WORKING.

the discharge-hole, two lugs, one on each side keeping it in position. The open space round the tube is then filled with clay. It is advisable to have the bottom of the vat six feet above the ground-level to allow of easy access to the conveyor underneath. At the spot where the sand is discharged upon the conveyor-belt, guide-doors are arranged parallel with the belt to prevent sand going over its edge, and the number of idlers under the conveyor is increased to prevent it sagging under a rush of feed. The conveyor is usually a flat belt, 24 in. wide, traveling at 350 to 450 ft. per minute, 4-in. iron idlers being used.

This method has many excellent features; its ad-

*Abstract from *Min. and Eng. Review*, Melbourne, Australia.

vantages are: (1) The moisture of the drained tailing is less than in any other system; (2) the slime is drained at the same time as the sand; (3) dams for handling the slime and the cost of labor on same are eliminated; (4) dusting troubles are minimized on the dump, owing to the slime helping to set the tailing; (5) the angle of repose of the dump is increased, thus enabling more sand to be stacked per unit of ground-area; (6) no trouble with conveyors handling tailing will cause a stoppage in the main plant; (7) accurate sampling of products is possible, enabling shift-work to be kept under control.

The disadvantages are: (1) High initial cost of erection; (2) relatively high cost of labor in emptying vats; (3) clarification of solution is not usually as complete as is the case with other methods.

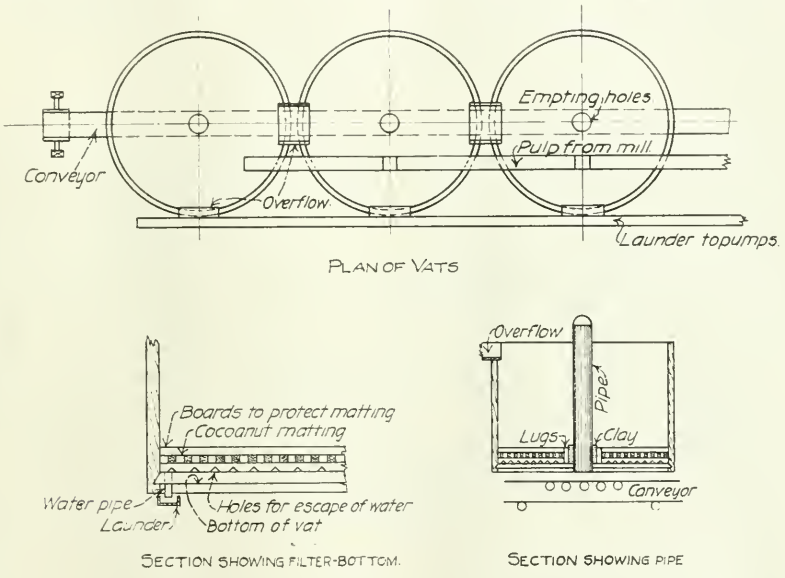


FIG. 1.

COMBINATION OF DRAINING-BELT AND THICKENERS. The idea of the submerged draining-belt, I think, was first introduced in connection with the Elmore process in order to overcome the difficulty of discharging the residual pulp without upsetting the vacuum in the flotation apparatus. In this system the belt runs inside an iron trough filled with water, being forced into a semicircular shape by means of a spherical pulley, as shown in sketch, Fig. 2. The belt travels under water for a certain distance, rising at a slope of 15 to 20° onto the head pulley.

The drive is usually from the tail-end by means of a worm-wheel on the tail-pulley shafting. This tail-pulley is generally 6 ft. diam., and is faced on the outside with wooden boards to give the belt a better grip. The feed is, preferably, distributed to the belt by means of an iron launder with holes in the bottom, wooden guides being arranged to guard against sand getting between the under side of the belt and the trough. The trough has side launders attached to carry the overflow to Dorr thickeners, the number of the latter depending on general conditions, such as nature of slime, amount of water in circulation, etc. The submerged belt forms an excellent desliming system, by reason of the classification in the trough; its capacity is 4000 or more tons a week of mixed slime and sand. The draining of the sand is accomplished as it rises from the surface of the liquid in the trough to the head pulley.

In order to accelerate this draining action, a bumper is usually employed. This consists of an idler driven by two eccentrics. The vibration caused on the belt by the idler striking it underneath displaces a larger quantity of water from the sand, and thus reduces the proportion of moisture in the final product. An iron scraper is used for removing the tailing from the draining-belt; it may be kept under pressure by means of iron springs. This method is very good, especially where the room available for drainage is limited. It is also convenient where the height of the flotation-plant above the ground is small.

The life of the belt is less than that of an ordinary draining-belt, owing to the heavy pressure of the spherical roller, and the action of the hot circuit-liquors in which the belt is submerged. The labor for attendance is small. This method is at present in use on two of the large flotation plants at Broken Hill.

COMBINATION OF CONES, DRAINING-BELT, AND THICKENERS. This method, diagrammatically illustrated in Fig. 3, has been installed in the latest flotation-plant at Broken Hill. The size of the Caldecott cones usually employed is 12 ft. diam. and 10 ft. deep, the diaphragm being 2 ft. to 2 ft. 6 in. from the bottom of the cone. In most cases a plate-diaphragm is used, but the introduction of an

iron ball to serve the same purpose has been most successful. Where a cone of this type is used as a thickener, rather than as a slime-classifier, more pulp may be thickened, as the height of pulp need not be so finely adjusted. Still, it is customary to keep the level of the sand two feet from the top of the cone, as measured in the centre. The feed usually passes into these cones through a centre of the Callow type.

To remove the thickened pulp continuously and divert it onto the draining-belt, an ordinary plug may be used with advantage, provided coarse rubbish has been removed previously. Another

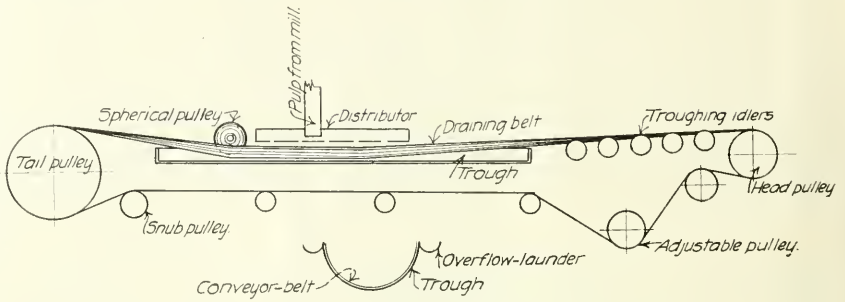


Fig. 2.

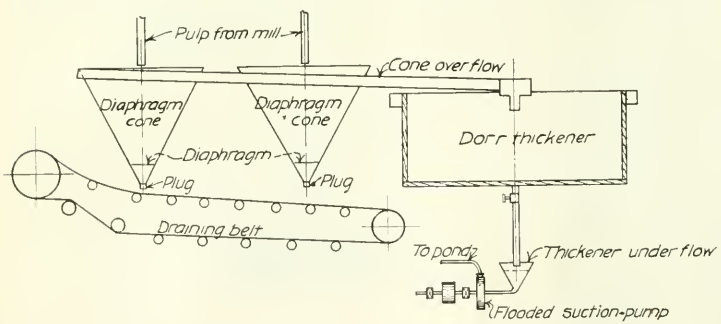


Fig. 3.

successful device is a plug-valve or a plug worked from the top, fitting into a seat at the bottom of the cone. The type of draining-belt employed is 36 in. wide. The belt rises gradually, about 1 in 60, from the tail-pulley, the last 30 ft. of the slope being increased to about 20°. The belt-speed is 20 to 30 ft. per min., both ordinary and troughing idlers, of 6-in. diam., being used. As the operation of the belt is slow, wooden idlers working in cast-iron 'dead-eyes' can be successfully used for the horizontal idlers, the troughing-idlers being of the usual type.

The drive is at the head end, double gearing for speed reduction being employed. The head-pulley is generally 5-ft. diam., the snub-pulley 18-in. diam., and arc of contact 200 to 250°. The tail-pulley is usually 2-ft. diam. Rubber belting on the face of these pulleys reduces the slip, thereby increasing the power-efficiency and the life of the belt.

The overflow from the Caldecott cones goes into one or more Dorr thickeners, according to requirements, the underflow from the thickeners, as in other methods, being handled with flooded suction-pumps. Attempts to mix the underflow from the Dorr thickener with pulp on the draining-belt in order to convey them together to the dump have not so far proved successful. For the control of the underflow from the Dorr thickeners the hydrometer method (described in 'Rand Metallurgical Practice') has proved quite satisfactory, a constant pulp, with Broken Hill slime, of 50% solid being easily maintained. This method is considered a good one, because the cost of labor is low, the life of the draining-belt is prolonged, and the cost of maintenance is small. Adequate headroom is, however, necessary for the erection of the cones;

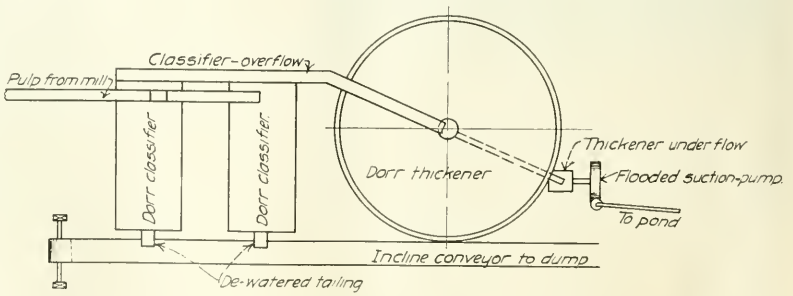


Fig. 4.

in some cases elevation is essential. A disadvantage is that a stoppage of the dump-belts causes a stoppage of the whole plant.

Combination of Classifiers and Thickeners. This method has not, to my knowledge, yet been adopted at

any plant in Australia, but the great success that it has achieved at cyanide plants in America shows that it could be applied to the handling of tailing and slime products at Broken Hill. The usual type of Dorr classifier, however, would have to be specially lengthened to cause extra draining of the sand product. Owing to the regular working of these machines the usual draining-belt may be discarded. At the same time very little head-room would be required. This method is illustrated in Fig. 4, which shows the classifiers delivering direct onto the inclined belt. It has, however, the same disadvantage as the method last mentioned, in that it does not make the treatment-plant independent of the dump-belt stoppages. The cost of erection and maintenance would, however, be small.

Handling of Drained Products. Tailing may be handled in the following ways: (a) Inclined conveyor-belts and boom-stackers, (b) aerial trams, (c) trucking, and (d) sluicing.

Inclined Conveyor-Belts and Boom-Stackers. The usual angle for an inclined conveyor is 20°; where possible the conveyor should be driven from the head-end. Where the head-end is high above the ground, the drive should be either from the tail-end or from a large centre-pulley, midway along the belt, having a snub-pulley at each side above it, the centre-pulley being 6 to 8 ft. diam. and resting, preferably, on a concrete base.

The inclined conveyor is first of all built on trestles at the angle required. As the size of the dump increases, the conveyor is extended in the form of a cantilever, held by guy-ropes from the upright trestles in the dump. A belt to handle 40 to 50 tons per hour would require to be one of 24 in. six-ply rubber built on 3 by 10-in. stringers, placed 3-ft. centres. If driven from the head-end, the driving pulley should be 5 ft. diam. gear-driven, the tail-pulley being 2 ft. diameter.

The Australian practice is to use separate rollers and troughing-idlers instead of a combination idler. This practice is simple; the idlers can be more easily lubricated. The best size of roller is 4 in. diam. It is usually made of steel pipe shrunk onto cast-iron end pieces. A favorite practice is to have idlers and dead-eyes on the top of the same stringers, the loaded and return belt running on rollers supported by the same, and being about three inches apart. The top rollers are usually spaced 4 to 6 ft. centres, the return idlers being spaced at twice this distance apart. Wooden rollers for fast belts of this type are not satisfactory,

In calculating the power required for this type of belt it is well to remember that the horsepower lost in friction per 100 ft. varies inversely as the length of the belt, averaging from 2 to 6 hp. per 100 ft. A tightening arrangement is usually fixed on the tail-pulley of this type of belt to cause it to run true and take up any unnecessary slack. When an inclined conveyor has been carried out to an economical distance, the tailing at its end is made into a bed for a boom-stacker. This is an iron pole, which is held in position by four strong guy-ropes. Attached to the pole is an iron lattice-girder, which is supported similar to a cantilever by guy-ropes attached to the pole itself. This boom-stacker rests on a steel ball in a cup-shaped receiving device, which enables it to swing around as desired. The weight of the boom-stacker is spread over a large area by means of a number of heavy timbers resting in the prepared foundation on the dump. The conveyor on the boom-stacker is driven by a motor fixed behind the boom, and traveling around with it. [The accompanying photograph shows a good boom-stacker at Kalgoorlie, Western Australia, from which place the Broken Hill system was largely copied.—Editor.]

Aerial Trams. These are so well known that they need no description here. For moderate tonnages they are seldom used, as a bin is required and two men loading and operating trucks.

Trucking. This system is followed only in special cases.

Sluicing. There are no features in this method requiring particular mention.

Handling of Slime. The pulp from Dorr thickeners is either transferred by flooded-suction centrifugal pumps or three-throw pumps, or else elevated by an ordinary belt-elevator. Where there is room for a slime-dam close to the treatment-plant, the belt-elevator, which is a very economical system of elevation, may be used. In other cases centrifugal pumps are resorted to. The thickened pulp may also be delivered to dams or sprayed onto the surface of sand-dumps. The banks of the dams are gradually built up by the slime. To remove the drained water it is preferable to use a wooden box-launder. This consists of two box-launders connected in the form of a right angle, and fixed in position at the commencement of the building of the dam. The horizontal portion of the launder is laid about 12 ft. inside the dam, and is carried to the water-sump outside it. The vertical portion passes through the slime and is bored with holes, which are plugged from the bottom upward as the building of the dam proceeds. Probably the best method of handling slime-pulp is to pump it through a nozzle onto the surface of sand-dumps. By such means it may be sprayed evenly all over the dump. This does away with dams, and checks the dust rising from the sand-dump. The idea was first originated in South Africa, and has only lately been introduced into Australia.

Disposal of Australian Lead. Australia produces 10% of the world's lead production, most of it from Broken Hill, New South Wales. In view of recent investigations the following table of the sale of the Broken Hill Proprietary Co.'s ouput should be of interest, by half-years in tons:

Destination.	1913.	1914.	1914.	1915.
Europe	30,606	22,341	13,896	1,100
India, China, and Japan	7,020	12,968	8,432	12,075
Australia and New Zealand	4,686	5,100	5,475	4,337
Vladivostock (Eastern Siberia)	....	.....	.....	1,450
Total	42,312	40,409	27,803	18,962

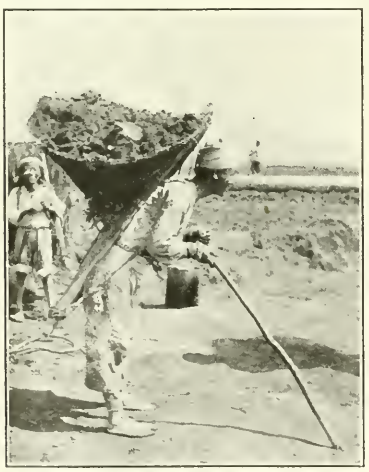
Shipments to Vladivostock were for the Russian government.

Prospecting on the Chiksan Concession

By CHARLES W. DE WITT

The area of the Chiksan Concession is approximately 100,000 acres; it is situated about 60 miles south of Seoul (the largest city in Korea) and 15 miles west of Tsun Po bay on the Yellow Sea. The elevation of the main range of mountains reaches 2000 ft. The majority of the veins lie in this range. The general trend of the mountains is North 60° East, the strike of the principal veins following in the same general direction.

One main fissure has been traced practically the full length of the Concession, a distance of 13 miles; it is on this fissure that the Chiksan Mining Co.'s principal mines are located. Numerous smaller veins are found



COOLIE CARRYING 250 POUNDS.

west of the main range, in the low rolling hills between the mountains and the sea.

The vein material is a medium-hard quartz containing pyrite, galena, and free gold. The country-rock is schist and granite, traversed by dikes of pegmatite. A greenstone of the pyroxene group, dark-brown where oxidized, is found widely over the Concession and in the company's mines at several places. Practically all the veins, large and small, are faulted and cut by dikes at many points, indicating extensive earth-movements.

The native prospectors follow somewhat the same system as the pocket-tracers of California and Oregon, that is, they find the spot in the vein where the best ore is found by repeated panning of the decomposed surface outcrop. When a native has discovered the vein in place, he gets his samples and brings them to the company's assay-office, where all such assaying is done free of charge; if the assays are of sufficient value he is encouraged to continue, and an order is made on the main office to issue him a license to work as a tributer on the Concession.

The prospector will then sink his shaft or drive his adit, as the case may be. Shafts have only one compartment and hoisting is by hand with a windlass. Tunnels are only 4 ft. high by 3 ft. wide. Tramming is accomplished by coolies. As little timbering as possible is done and big chances are taken with caves. However, the same native would not work in a company mine under these same conditions, as he would think it too dangerous. Despite such methods there are exceedingly few accidents, which is probably due to the fact that a

GRINDING WITH A ROCKING-STONE.

Korean has no fear of personal injuries, and will venture where no white man would think of going.

I have seen cases where a miner has fallen down a winze 100 ft. deep and come out with a broken arm and a few bruises; the strange part of it is that there are more fatalities caused from falls of 15 to 25 ft. than from greater heights.

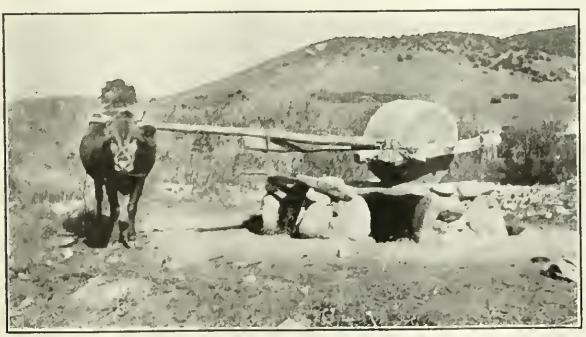
Another method of prospecting is to allow the prospector to work his mine, and pay the company a small amount per man employed. This method has its drawbacks, as one cannot watch them closely; when they pay for one man they will work a dozen; moreover, they will steal powder and drills from the other tributers, which causes trouble among them. The tributers grind the ore by hand or by the use of either the rocking-stone or the rolling-stone. In some places a long distance from the company mill, the Koreans have erected a small 10-stamp

wooden mill, which has a capacity of about two tons per day, when there is plenty of water. This method of prospecting is being discontinued, as neither the prospector nor the company derives any profit therefrom.

None of these small veins has so far proved of any importance, owing to their narrowness; they vary from a few inches to two and three feet in width; the lenses of ore are invariably short, running from 25 to 100 ft. in length, and to a depth of a few feet to 150 ft. for some of the wider veins. Inasmuch as some of these veins are quite rich, the native who finds an ore-lens soon becomes a man of importance; to show his importance he acquires several additional wives; this generally ruins his usefulness to the company, but his success is a great incentive for the others to take the field and look for other rich mines.

The license under which the tributer is working is printed on a piece of wood, 3 by 4 inches, in three languages, Korean, Japanese, and English. This is necessary, as we employ inspectors who go from place to place. The tributer must keep his license with him as his protection, for, should an inspector find him working without the proof of such authorization, everything is confiscated, including the ore mined, and the tributer himself becomes liable to a fine. Japanese and Koreans are used as inspectors, but any member of the foreign staff that happens to pass by may demand to see the license. That is why one side is printed in English. It was found necessary to follow this method in order to prevent prospectors from finding rich spots and carrying off the high-grade to some native grinding-mill, without paying anything to the company.

The ore is carried from the tribute mines to the company mill by means of bulls, both the pack and wagon being used. A bull will pack from 300 to 800 pounds, while the wagons will carry from 1000 to 2000 lb., the driver generally carrying about 50 lb. on his own back.



A ROLLING-STONE GRINDER.

These men receive from 17½ to 20 cents per ton hauled per mile of distance.

Before the ore is shipped to the mill, it is reported to the officer in charge of the prospecting on the Concession; he goes, or sends a trained sampler, to take preliminary grab-samples of the ore to be shipped; if the assays are sufficiently high to warrant treatment in the mill, he authorizes the shipment. A careful sample is then taken at the mill for final assay, on which settlement is made. This settlement is arranged on a sliding

TRIBUTE PROSPECTING.

scale, ranging from 33⅓ to 50% of the gross assay-value.

If a prospector has found a good-sized vein and the ore is not high in value, but sufficient to pay even a small margin over the milling-cost, the prospector is allowed a higher percentage, in the hope of his developing a profitable mine when he gets his workings a little deeper. This larger percentage also applies to prospects that are at a long distance from the company mill, in order to compensate for the long haul. The tributer is also assisted in the furtherance of his work—once he has proved that he has a prospect of any value—by supplies from the company store, where any tools, explosives, and candles will be sold to him at cost, and the amount deducted from his next shipment of ore. This is a great advantage to the natives, as otherwise they could not get explosives at all for small operations, the Japanese government officials being very strict, and all explosives must be carefully accounted for at the end of the month.

On some of the concessions owned by other foreign companies, the prospecting is conducted under a department of the company itself, and their expenditures amount to about $50,000 per year, with little or no ore milled. The Chiksan company has issued 215 licenses, which means that about 200 veins have been uncovered,

leading to the discovery of the main mines of this company; furthermore, the prospecting has been a source of considerable revenue in the past few years, since the tribute system was established.

During the year from July 1914 to July 1915 the tribute-ore milled amounted to 13,680 tons, with a gross assay-value of $86,658, this being purchased from the prospectors for $33,615, the remaining $53,042 being the company's realization.

Under this method of prospecting, and of purchasing the ore from tributers, the natives are thoroughly contented, and are kept ever on the look-out for new prospects. We furnish all the necessary supplies, so that they need not worry while the mine is still unable to produce. By working for themselves in this manner, they feel more independent and above the ordinary coolie class, so that they can get money and credit from their own people. Their finish comes when the mine does not produce as expected and their creditors commence to worry them. At this stage of the game, they generally wait until a very dark night: leaving this part of the country to try their luck elsewhere.

Rock-Drilling Practice on the Rand

*Rock-drilling speed varies nearly inversely as the area of the hole bored, or, in other words, it costs about the same in time and compressed air to excavate one cubic inch of the same rock as another. Are short or long holes more efficient? Disregarding the time lost in starting a hole and adjusting the drill, we find that in the time required to drill one 8-ft. hole (drilling 2 ft. each with steel having bits 2¼, 2, 1¾, and 1½ in. diameter respectively) there can be drilled nearly three 6-ft. holes (drilling 18 in. each with bits 1¾, 1½, 1¼, and 1⅛ in. diameter). By using $\frac{3}{16}$-in. difference in gauge of bits with 18 in. change of steel for the 6-ft. holes, more than three 6-ft. holes can be drilled. Or there could be drilled, in the same time, five 4-ft. holes, starting with a bit of 1⅜ in. and drilling one foot each with 1⅜, 1¼, 1⅛, and 1-in. bits. What is the best length of hole to use; what diameter should be the bottom of the hole; what difference in gauge of bits should be employed; what difference of length in change of steel; what grade of explosive is best for small-diameter holes? Are long holes more wasteful of explosive than short holes? The amount of explosive necessary varies as the square of the burden, so that a hole with a 3-ft. burden requires nine times the explosive charge needed in the hole with a one-foot burden.

Using light water-hammer drills that theoretically can be worked by one native, it was found that the predicted drilling speed could not be realized, so that in practice more natives were required than with piston-drills, principally because the Kaffir can run a simpler machine more efficiently. This does not say that there may not be a design of hammer-drill in existence or in preparation that will not prove to be both a one-man drill and easily supervised.

As to drill-steel, it has been found that hollow steel is harder to sharpen and to temper correctly than solid steel, and in general the use of hollow steel with hammer-drills has proved much more expensive than solid-steel with piston-drills. In very hard ground, the blunting and wear of hollow steel is formidable, and bits are liable to chip away or prove too soft, so that a greater difference of gauge may be necessary than with solid steel. A tremendous importance attaches to having drill-bits true in every particular, so that not only should the shank be in a straight line with the axis of the piston, but the outside edges of the bit should be in a true circle. It is recommended by a skilled investigator that hand-sharpened bits be passed through a proper gauge-circle insuring that each bit be correctly sharpened and gauged. Machine-sharpening has, of course, much remedied these defects.

A blunt drill-bit merely bumps and crushes the rock, powdering its own chippings, instead of cutting the rock and advancing. It is a mistake to use similar drills for boring dry or upward holes as are used in ordinary wet holes. The difficulty of forcing water (with solid drill-steel) into dry holes, ordinarily makes necessary a bigger difference in gauge of successive bits than is required on steel for drilling wet holes. I would recommend for dry holes drill-steel of star section, twisted to form a rotary conveyor to pass cuttings down the hole, with 12-in. difference in length and ⅛ in. difference in gauge instead of the present ¼ in. difference. This should result in drilling upward holes in hard ground in half the time. Also it should make possible the cutting down of the difference in gauge of steel for wet holes to ⅛ or ⅛ in average ground. Such a change would mean that instead of a set of steel being 2¼, 2, 1¾, and 1½ inch for a seven-foot hole, we would use 2 or 1⅞ (starter), 1¾, 1⅝, and 1½ in., which would mean that the amount of ground excavated would be reduced 20% with corresponding increase in drilling speed. For harder ground, a $\frac{3}{16}$-in. difference could be employed, or, better still, the difference in lengths of steel could be cut down to 18 in. with ⅛ in. difference in gauge.

*Abstract of article by T. M. Weston in *The Mining Magazine* for August.

MOLYBDENITE deposits are in much demand at present. Shipments from Lost Creek, 14 miles from Salmo, Nelson mining district, British Columbia, made to the Henry E. Wood company of Denver netted the operators over $800 per car. The vein is 1400 ft. long; the ore varies at different points along the vein, a small quantity running as high as 30% but a good deal of the ore runs around 10%. The ore is said to be amenable to concentration, because containing practically no iron, copper, and metallic impurities that interfere with the successful application of the flotation process for recovering the molybdenite.

Flotation Plant of the Utah Leasing Company

By HERBERT SALINGER

*The new 500-ton plant of the Utah Leasing Co. at Newhouse, Utah, has been built to treat 1,000,000 tons of tailing from the old Cactus mine. The plant is what might be called strictly a flotation unit, as the complete treatment is centred in a Minerals Separation flotation-machine. In this respect it differs from most plants in which flotation is used to help concentration, as at this plant flotation is the sole means of concentrating the ore.

The tailing is taken to the feed-hopper by a drag-line scraper, and from this hopper is raised to the bins by a bucket-elevator. The ore is fed to two 8-ft. by 48-in. Hardinge pebble-mills, with extra large scoops, by means of two Allis-Chalmers Challenge feeders. The Hardinge mills are connected in closed-circuit with two Dorr Simplex classifiers, the minus 65-mesh material being sent to an elevator for delivery to the M. S. machine, and the oversize returned to the Hardinge mills for re-grinding.

Mineral in the tailing is almost exclusively chalcopyrite, but little tarnished. The copper-content, taking into consideration the slime, which averages considerably higher than the sand, is about 0.75% with small gold and silver value. The screen analysis shows:

All through 6-mesh:

Mesh.	%
On 8	5
On 14	25
On 28	28
On 40	18
On 65	6
On 100	5
Through 100	13

Fine material is the richest, that through 60-mesh being approximately 0.95% copper.

The M. S. machine is of the type known as 6–6 combination, being 12 cells arranged in series, six cells of which are of the single-spitz 24-inch standard cells, and six cells being of the double-spitz construction sub-aeration cells, known as the Hibbard cell. Eight hundred cubic feet of air per minute at 5-lb. pressure supplements the agitation in the Hibbard cells, the air being produced by a Roots blower. The M. S. machine is driven from a single line-shafting, the speed of the impellers being 425 to 450 r.p.m. The main body of the machine is entirely built of California redwood. The launders on both the standard and on the sub-aeration section are of the double type.

A concentrate is made in the first three standard cells, to the first of which is also added the feed from the classifiers. The sub-aeration cells make a middling which is returned to the head of the machine for re-cleaning. The concentrate is sent to large bins, of 200-ton capacity, for settling, and the overflow is pumped back to the Hardinge mills. All launders are 14 in. wide and 11 in. deep, the extra size being designed to take care of excessive froth.

Electric power is used exclusively, the power being received from the Beaver River Power Co. at 44,000 volts, which is stepped-down to 2200 and 440 volts respectively in the mill. The Hardinge mills are driven by a 150-hp. type CS Westinghouse motor, connected to a single line-shafting, driving both mills. The M. S. machine is driven by a Westinghouse 75-hp. motor. The drag-line drums are driven by a 35-hp. type K General Electric motor.

The enterprise is too new to afford data for ultimate practice. At present it is found that a mixture of light coal-tar creosote, Barrett No. 4, combined with kerosene acid-sludge from Nicols, California, has given the best results. Good work has also been done with crude wood-creosote, and the addition of a small amount of pine-oil and sulphuric acid. In general, however, the best results have been obtained in an alkaline solution rather than in an acid solution. Complete tests indicate that an average extraction of 80 to 85% is practicable. Almost all reagents are added to the Hardinge mills so as to get the benefit of the resultant mixing action. A small part of the reagents, however, are added at the head of the standard cell.

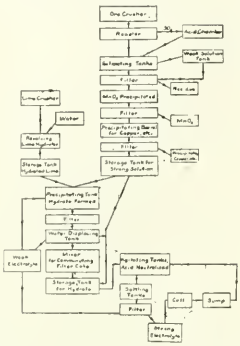
The officers and directors of the company are John H. Leavell, president; J. C. Dick, vice-president; D. R. Pingree, secretary and treasurer, and these, with F. W. Royer and Vivian P. Strange, complete the directorate. The superintendent at Newhouse is Harry H. Adams, formerly of the Stewart mine at Wallace, Idaho.

*Abstract from *The Salt Lake Mining Review.*

GOLD PRODUCED by mines in the United States during the past 18 years totaled $1,531,000,000 or an average of $85,000,000 per year. During the same period the excess of imports of gold over exports amounted to $12,000,000 per year, so that the absorption of gold by the country appears to have been practically $100,000,000 per year, after allowing for the gold contained in minor quantity in ores and silver brought into the country for smelting. Of course recent shipments of gold from Europe have amounted to more than $100,000,000 in a few weeks, but the occasion has been abnormal. It has been estimated that the United States absorbs a quarter of the world's production of gold, which has been about $460,000,000 per year during the past three years. An unknown quantity is taken from the country by travelers to Europe and by returned immigrants. It is not, however, an American trait to accumulate gold, as it is, for instance with the French.

Recent Patents

1,154,602.—Hydrometallurgy of Zinc. Otto Best, San Francisco, California. Filed March 26, 1913.

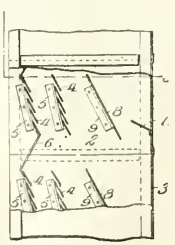


1. In the recovery of zinc from ores and other materials containing the same in an acid-soluble form, the method of obtaining a solution which comprises extracting the zinc with sulfuric acid, and treating the resulting solution before separation from the undissolved material with lime in amount insufficient to precipitate the zinc; substantially as described.

1,154,981.—Tube-Mill. William Fennell, Southam, near Rugby, England. Filed Apr. 25, 1913, Serial No. 763,524. Renewed June 2, 1915.

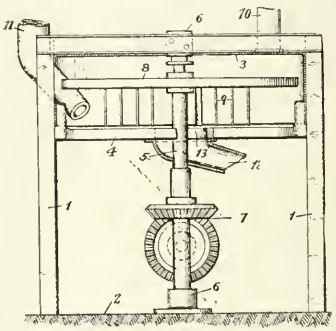
1. The combination with a tube mill of a large number of loose freely movable grinding bodies each made of a length that is equal to a fraction only of the radius of the mill but is of greater length than diameter and has an open ended passage extending lengthwise therethrough and a hole in its peripheral surface of less width than that of the surface adjacent to said hole, substantially as and for the purposes set forth.

1,155,292.—Ore-Separator. Edward Torrey, Thetford Mines, Quebec, Canada. Filed Aug. 9, 1912.



1. An ore separator comprising a chute having two or more rebound devices disposed laterally across the chute, each of such devices comprising a plurality of plates arranged in louver formation; and means disposed laterally beyond such devices for separating the material rebounding therefrom from the remainder of the ore.

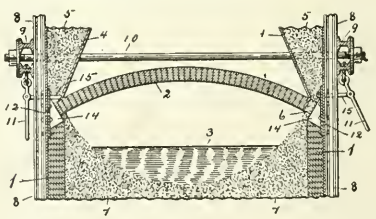
1,149,264.—Cooling Ore. William H. Hubbard, Jr., Salida, Colo., assignor to The Ohio & Colorado Smelting & Refining Co.,



Denver, Colo., a Corporation of Colorado. Filed Nov. 30, 1912.

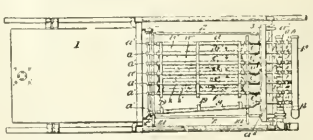
1. In apparatus for cooling hot ore or the like, the combination with a flat circular cooling table for supporting the ore in a comparatively thin layer, means for charging the ore onto the table, means for discharging the ore from the table, rabbles for rabbling the ore on the table and for effecting movement of the ore from the place of charge to the place of discharge; a hood inclosing said table and rabbles, a stack at the top of said hood to conduct the dust and gases away from said rabbles and to insure a circulation of air for progressively cooling the ore on the table during its movement from the place of charge to the place of discharge; substantially as described.

1,149,495.—Metallurgical Furnace. George Campbell Carson, Denver, Colo. Filed Jan. 15, 1907.



In a metallurgical furnace having receptacles arranged above the roof thereof, passages from said receptacles leading to said furnaces arranged in such a manner that the material in said receptacles passes out into said furnaces by gravity and form the lining thereof.

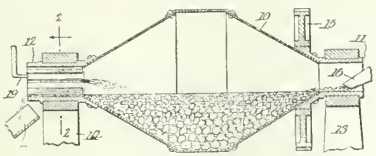
1,158,056.—Filtering Apparatus. David J. Kelly, Salt Lake City, Utah, assignor to Kelly Filter Press Company, Salt Lake City, Utah, a corporation of Utah. Filed October 22, 1913.



1. A filtering apparatus of the open-leaf type having in combination a pressure tank, a carrier removably contained there-

in and adapted to be surrounded by the contents thereof, said carrier being provided with a plurality of filtering elements arranged in spaced relation and between the opposed surfaces of which a solid cake of deposited material is adapted to be built, each of said filtering elements being subjected to the common pressure of said tank, and means for admitting a wash solution to the interior of alternate of said filtering elements, whereby values retained in the cakes are displaced and conducted by the wash solution into the interior of the intermediate filtering elements.

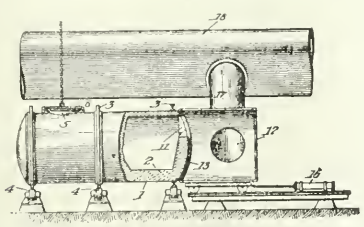
1,149,826.—Sizing Apparatus. Harry W. Hardinge, New York, N. Y., assignor to Hardinge Conical Mill Company, New York, N. Y., a Corporation of New York. Filed Dec. 23, 1914.



1. In an apparatus for the purpose set forth, a rotary tubular outlet member for the outflow of disintegrated material, having on its inner surface a plurality of channels extending in a generally longitudinal direction, and means above the outflowing material for discharging fluid into the channels in a direction opposite to that of the outflowing material.

2. In an apparatus for the purpose set forth, a rotary tubular outlet member for the outflow of disintegrated material having on its inner surface a plurality of channels extending in a generally longitudinal direction, and a jet pipe arranged to discharge fluid inwardly into the channels above the surface of the material flowing out through said tubular member as the latter rotates.

1,153,921.—Converter for Treating Matte.—William H. Howard, Garfield, Utah. Filed Mar. 2, 1914.



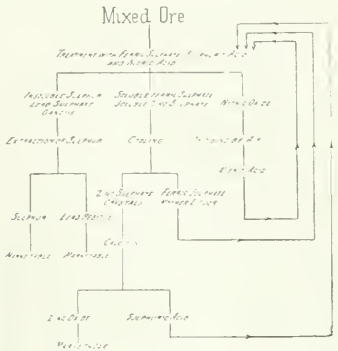
1. A converter for treating molten metal which comprises a horizontal cylindrical shell mounted to rotate on its horizontal axis and having its discharge opening for smoke and gases in one end near its upper side and eccentric to its axis, and a stationary hood into which said opening discharges.

2. A converter for treating molten metal which comprises a horizontal cylindrical shell mounted to rotate on its horizontal axis and having its discharge opening for smoke and gases in one end near its upper side and eccentric to its axis, in combination with a cylindrical stationary hood concentric with said shell and inclosing said opening at all positions of the shell.

1,148,814. Metallurgy of Copper. Lawrence Addicks, Perth Amboy, and Clarence L. Brower, Chrome, New Jersey. Filed August 9, 1913.

1. The refining of nearly pure copper by simple melting under non-reducing conditions and in the presence of only sufficient acid material to slag off the small proportion of impurities contained while minimizing the formation of slag by avoiding contact with acid lining material, and subsequently poling out the small proportion of cuprous oxide incidentally formed.

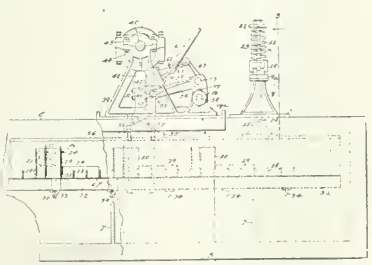
1,157,153.—Process for the Industrial Separation of Lead and Zinc Contained in the State of Sulfids in Ores. Guy de Bechi, London, England. Filed March 29, 1913.



1. A process for the industrial separation of lead and zinc contained in the state of sulfids in ores consisting in reducing the ore to an impalpable powder, treating said powder by a mixture of ferric sulfate, sulfuric acid and nitric acid, whereby the sulfids are transformed into sulfates with formation of free sulfur, and separating the zinc solution from the lead sulfate by filtration.

2. A process for the industrial separation of lead and zinc contained in the state of sulfids in ores, consisting in reducing the ore to an impalpable powder, treating said powder by a mixture of ferric sulfate, sulfuric acid and nitric acid, whereby the sulfids are transformed into sulfates with formation of free sulfur, separating the zinc sulfate from the lead sulfate by filtration, and regenerating the sulfuric acid of the zinc sulfate.

1,159,295.—Jig. Walter T. Tower and Peter D. Camphuis, Wallace, Idaho. Filed July 28, 1914.



1. An ore jig, comprising a tank, a jig screen therein, means for oscillating the same, a plurality of spaced plates arranged transversely therein to retain ore therebetween to form a bed of ore, a cup in said screen consisting of a casing open at top and bottom and having an opening in the lower part of the front thereof, an adjustable gate for controlling the height of the upper edge of said opening, a partition in said cup arranged transversely thereof and provided with an opening intermediate the height thereof, an adjustable gate for controlling the height of the lower edge of said partition opening, and diagonally inclined overflow plates of greater height than said transverse plates leading from the walls of said screen to said cup to direct ore to the opening in the front thereof.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

WASHINGTON, D. C.

Rescue and Experimental Stations.—Mining Laws.—Radium-Bearing Areas.—Leasing Mineral Lands.

It is the determination of those in Congress responsible for mining legislation to procure affirmative action on the various proposals, which, with the exception of the bill for rescue-stations and mining experimental-stations, failed to pass in the last short session, chiefly because of the congestion of business. In the Senate, Senator Walsh of Montana continues at the head of the committee on mining, while Representative Foster of Illinois is at the head of the similar committee of the House. Both have been for some time identified with these committees, and both have declared anew their zeal in favor of action on such mining legislation as has been proposed. Already the proper bills are being drafted for introduction. In the main they will follow the bills introduced and discussed in the last Congress.

The chief legislation is to address itself to the enactment of the bill creating a commission to codify the mining laws of the country. It was hoped to procure the passage of this bill in the last session, and while such a bill passed the Senate, a similar bill failed in the House, where, however, it got as far as the calendar. There was one important difference: that of the Senate proposed an appropriation of $25,000 to defray the expense of the commission, while that of the House omitted this provision. The House felt the impulse of economy, and allowed the bill to die. It would, of course, be ridiculous to create so important a commission without means to defray its expenses. The mining men in the House are determined this winter that their bill shall carry an appropriation. It is the plan of Mr. Foster to introduce a bill to the foregoing effect at once, induce committee action with all speed, and so have the bill placed on the calendar of the House near the top for early consideration. The bill had some opposition aside from the appropriations committee of the House. It is planned to have a thorough codification of the mining laws on the Federal statutes, but there are some who think it would be a grave mistake to touch the apex laws, the belief being that it would be well to leave these laws alone inasmuch as the courts have thoroughly established the law and the practice relative to apex mining, and that to inject a change in them would be provocative of fresh litigation and confusion.

Congress is to have the benefit of mining men themselves through the special committee appointed by the American Mining Congress, of which E. B. Kirby, of St. Louis, is the chairman. This committee has made a report in which it is pointed out that the present laws were framed in 1872, and are 40 years behind the times. "They have," says the committee report, "never conformed to the facts of geological structure, and are not adapted to present methods of prospecting, developing, or financing mining properties. The widespread dissatisfaction of the mining public with them has long been expressed through every means at its command." The report declares that the forces back of the revision movement have steadily grown in strength, and that at last the American Institute of Mining Engineers is now free to devote its energies to the cause. In view of the fact that it has been stated in Congress that some engineers have been opposed to apex changes, this last circumstance is important. A preliminary draft of a suggested bill has been placed before the proper committees of Congress and this bill provides that the President shall appoint within 60 days after the passage of the bill a commission of five members of recognized knowledge and experience in the mining industry, which shall give hearings and make recommendations in the form of a fully drafted mining code, reporting to the President within six months, and that the President shall transmit it within 30 days to Congress with his further recommendations, if any. The bill provides additionally that the members of the commission shall have *per diem* expenses. It is the opinion of some mining members of Congress that such a commission should be able to do its work in 60 days after being named, and that if such expedition can be procured the codification can be made law at this session of Congress, which is expected to last well into the summer, if not into the autumn. The committee of the Mining Congress is to have a meeting in Washington, beginning December 16, and it is expected much energy will be expended to procure the passage of this codification.

The radium bills are to be pressed again. These contemplate the conservation by the Federal government of public lands bearing radium, into the production of which the Government is to go for a certain period. The bills have been vigorously opposed, and especially in the Senate, out of fear that they would establish a dreaded precedent in Government manufacture. This contention has had great force up to the time the Government set about trying to produce radium, and it was declared that it would be a failure, but since the Government has been able to produce radium at the rate of about $40,000 per gram, a reduction of $80,000 in the price, the argument is not feared. The Colorado senators, however, dread a vast withdrawal of Government land in their State for radium production, and they do not want any more lands withdrawn from the uses of the people. They are expected to fight the bills with their accustomed vigor, which, however, will be easily overcome should the Senate adopt cloture rules.

The bills for the leasing by the Government of coal and mineral lands now in its possession are again to be pushed. Senator Walsh is most enthusiastic about them. With them goes the proposed legislation for water-power. These so-called conservation bills are backed by the Administration, and in particular by the Interior department. They were discussed a good deal in the last Congress, and failed of passage because of the opposition, which became effective through the jam in all legislation caused by the effort to procure the passage of the Ship Purchase bill.

MONTERREY, MEXICO

Conditions in Nuevo Leon, Durango, Coahuila, and Zacatecas.

While conditions are still very unsettled in the states of Chihuahua, Sonora, Sinaloa, and parts of Durango, quiet prevails in the remainder of the republic, with indications that it may be of some permanency. Considerable quantities of mining machinery are coming in from the United States, and the overhauling of the mills and other general equipment is expected to progress rapidly. The Southern Pacific and other railroads of the United States are now permitting their freight-cars to enter Mexico, and this addition to the equipment of the National Railways of Mexico will enable the more prompt handling of ore between the mines and the smelters, and the

hauling of supplies and other products. The smelters at Monterrey, San Luis Potosi, and Aguas Calientes have ordered large quantities of coke, which will soon begin arriving from the United States.

One of the favorable signs of the improved condition of this part of the country is the re-opening here of several mining company offices that had long been closed. The Compañia Minera de Peñoles brought in a full complement of officials and clerks from the United States a few days ago, and established them in new offices in Monterrey. The mines of this company are situated at Mapimi, state of Durango, and are among the richest in the republic. The working force at the mines is being organized, and it is planned soon to have the property running full time.

The rich copper mines at Jimulco, state of Coahuila, which are owned by a syndicate of San Antonio, Texas, men, headed by Otto Wahrmund, will be operated again in a short time, after a long shut-down.

In the Mazapil and other districts of the state of Zacatecas, mining has been resumed on a considerable scale.

JOPLIN, MISSOURI

Prosperous Conditions Compared with Mining Industry of Year Ago.—Many Mines Change Ownership.—High Recovery from New Picher Plant.—Zinc and Lead Notes.

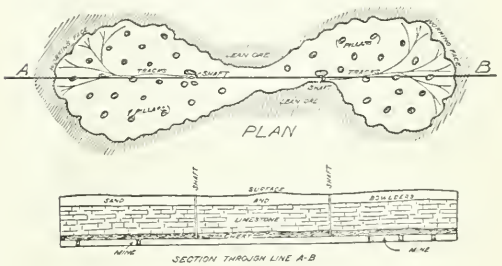
More activity is noted in the Missouri-Kansas-Oklahoma zinc and lead region than at any time in its history; more new concentrating plants are under course of construction than ever before; more mining deals are being consummated; and prices, at the beginning of December, while lacking a few dollars of being up to the record of last August, when a top figure of $135 per ton was reached for zinc concentrate, are more than double those of the corresponding week of 1914. November witnessed the price gradually advance until, at the opening of December, bids ranged from $105 to $115, basis of 60% metallic zinc, for high-grade ores, and from $85 to $105 for second grades. The average basis price of blende for the month of November was $99.35, or almost $20 higher than the average for October, and as a result of the higher basis the majority of operators have increased the wages of their workmen for the ensuing month. Machine-men, who got $3.75 per day in November, will receive $4 throughout December; and helpers, who got $3.25, will now get $3.50. All other workmen receive proportionate increases in wages.

Among recent mining deals, the sale of the Black Hawk and the Lucky Tiger mines at Neck City, Missouri, is important, the price paid for the two properties being $125,000. Formerly owned by G. L. Cole, these two properties now are being operated by the Knight Investment Co., of Utah, and are holding up to their old record of productiveness. The purchasers acquire the first lease on 40 acres on which the two mills, each of which has a capacity of 300 tons per shift, are situated. The Lucky Tiger has been producing for a year or more, but the Black Hawk is a newer property, having been productive for only a few months.

The Providence No. 2 mine and mill, which recently was acquired by E. D. Hornbrook, will soon be producing concentrate. Situated on a lease of the Zinc Corporation of Missouri's land, south of Webb City, Missouri, this mill is the largest in the immediate vicinity. Several years ago the mine was operated by the Yale Mining Co., and later was taken over by the Providence. Owing to an extremely heavy flow of water, mining was abandoned for some time, but the present operators now have their property drained and everything is ready to begin production. The plant is electrically driven and is capable of handling 500 tons of ore per shift. Mining is conducted in sheet-ore at a depth of 190 feet.

St. Louis bankers have acquired the Blue Bird mill and lease of 80 acres of the Cooper land, north of Miami, Oklahoma, for $125,000. The property was owned by the Church & Mabon Mining Co., operators of some of the largest mines in the Oklahoma district. The mine was purchased on its prospects for becoming a producer, rather than for its past record, as the lease had never been placed on a highly productive basis. Although numerous drill-holes showed good ore at from 260 to 300 ft. in depth, Church & Mabon did not sink to this level, but worked an upper shoot which was not profitable. The extremely heavy flow of water encountered in the deeper ground handicapped operations while prices were low, but with present quotations the deeper ground, it is thought, can be worked successfully. The mill is rated at 250 tons' capacity, and it is claimed the orebody has been blocked-out in drilling for a distance of 3000 ft. from north to south. To the north-east is the new mill of the Blue Goose Mining Co., which is now making a large quantity of concentrate from the deeper ore deposits.

An interesting little occurrence, showing how easy it is sometimes for one to stumble onto a fortune, is reported by the Rex Mining & Smelting Co., owning a 1000-acre tract of



SKETCH OF A JOPLIN SHEET-GROUND MINE.

land east of Joplin. Lou Moffett and son, who drove from Arkansas to Joplin in a covered wagon, chanced to camp at a favorite spot on the Rex tract, but unlike scores of other movers who pull in over night and leave next day, Moffett heard of the big money being made in zinc, inquired around regarding the methods of mining, and in the course of a day or so procured the right from the Rex company to cull over some old dumps. He had never seen a piece of zinc ore, to know it, before, but he soon acquired the ability to distinguish the 'pay dirt' from the other, and with the aid of his son made a clean-up the first week that netted $20 each, the most real money Moffett had ever earned in such a short time. The next week he converted his moving wagon into an ore-wagon, hauled many loads of crush rock to a custom-mill, and after six days of diligent toil he sold $496 worth of concentrate. The net profits after the milling bill of over $200 and the royalty had been deducted, aggregated $110 each, $220 between father and son. The old bearded mover and his son had chanced to discover a large 'crush-pile' that had been discarded as worthless by some early day miner who had mined only for the lead, and who had thrown the zinc away. They have enough material to keep them busy for a year or more.

The initial run of Picher mill, No. 1, at Picher, Okla., the newest district, showed the ore to yield 23% blende and galena, remarkable for a hard-ground mine. Elsewhere throughout the district successful operations are being conducted in 2% ore, and seldom is a recovery of better than 3 or 4% recorded. The mill is the first of a series of five to be built immediately, and it has a capacity of 300 tons per shift. Mining begins at a depth of 262 ft., and continues down to 280 ft. Electricity is the power used at the mill.

A company made up chiefly of Chicago suffragists, and known as the Woman's Federal Oil Co., has tackled the biggest drainage scheme in the district, and one which has caused many seasoned operators to get 'cold feet.' They have

leased 493 acres of the United Zinc Co.'s land at Peacock, Missouri, eight miles north-west of Joplin, and four large Texas pumps have been installed to drain the ground to a depth of 150 ft. Ultimately mining will be extended down to 180 ft., where good ore is shown in many drill-holes. The Chicago-Lehigh mill of 300-ton capacity will be moved from Carl Junction, Missouri, a distance of 5 miles. Beginning in 1899, and continuing until about 1908, the Peacock land was a heavy producer. The land lies in a low river valley, and is frequently submerged by flood waters. One of the first steps of the new company will be the construction of a strong dike along the banks of the near-by streams.

KALGOORLIE, WESTERN AUSTRALIA

THE WESTONIA FIELD AND EDNA MAY GROUP.—CHAFFERS AFFAIRS.—PROSPECTING.—SAND QUEEN.—LANCEFIELD.—IVANHOE.—ORE RESERVES.

One of the government geologists, T. Blatchford, has made his preliminary report on the Westonia district, near Southern Cross, and considers that there is no geological reason why the Edna May and Central line of lode should not persist to a considerable depth. The lode consists of a series of lenses and bands of quartz mixed with kaolin and country-rock, with an ususual strike. This varies from north-east, where encased by gneissic rock, to north-west, where the foot-wall is greenstone. The lode thus resembles a hook in shape. The underlie in the gneissic rock is north-west, and at the south-west end in the Edna May is north-east. M. Blatchford points out that narrow granite bars are frequent in the gneissic rock, and in several instances may be seen passing through the lode, but have had practically no effect on it. Since the cross-cut struck water at the 300-ft. level, in July, when the flow was estimated at not less than 750,000 gal. per day, work has been suspended, awaiting the arrival of the three electric pumps ordered. In the meantime a diamond-drill hole put down from the north drive at the 250-ft. level of the Edna May Deeps, passed through the lode at an inclined depth of 208 to 243 ft., calculated to be a vertical depth of 443 ft. from the surface. The bore-hole core from 208 to 216 ft. assayed $2, and from 216 to 243 ft., $30.34 per ton. Where the bore first pierced the lode it was estimated to be only 12 ft. north of the Edna May boundary and 50 ft. from the corner of the Central. The managers of all three mines claim that his own mine receives the greatest benefit, with the result of a wild gamble in all the shares. Deeps, which were $1.44 in the middle of September, were over $5 two weeks later, with wide fluctuations in the interval. Other shares show less advances. Owing to the heavy water encountered, nothing definite is likely to be known this year. The Edna May still continues paying its regular monthly dividend of 72c. per share, making its total $660,000, out of $1,010,000 gold produced in 2½ years.

During the half-year ended April 30, 1915, work was done down to 225 ft. The bottom level is now at 300 ft. Reserves are estimated as 60,100 tons worth a total of $1,300,000. The mill and cyanide-plant treated 17,257 tons and 14,900 tons respectively, yielding a total of 19,738 oz. gold. Six dividends of 72c. each per share were paid. The output in 2½ years is $1,010,000 from 49,572 tons, and $470,000 in dividends. The capital is 50,000 shares at $2.50 each. Costs are $3.46, and development charge, $1.64, a total of $5.10 per ton.

The attempt to re-construct the Chaffers company at Kalgoorlie having failed, the mine and equipment were sold by auction on October 27. The sale is hardly likely to realize sufficient to meet the liabilities. So far as can be learned the mine is worthless down to 2261 ft. Wages owing amount to $8200 since October 18 of 1914, and other creditors nearly $100,000.

Latest reports from the Mt. Holland district are unsatisfactory, and the long looked-for new goldfield seems as far off as ever. The McIntyre prospecting party reached the district recently and will thoroughly investigate it, and then continue on to Phillips river. The season still continues favorable for prospecting, the rainfall in September at Kalgoorlie being 0.18 in., making a total for the year of 16.18 in., against an average of the previous seven years of 8.90 in. for twelve months.

The State's gold output in August was worth $2,145,540, dividends $191,600, making $617,682,500 and $127,180,200 since 1866.

The Sand Queen mine at Comet Vale, owned by Frank Moss, formerly manager of the Kalgurli, and his brothers, is opening well again. The lode at 500 ft. faulted badly, and was broken and worthless; but at 650 ft. it has been found almost similar in characteristics as before. The mine has produced $1,553,700 from 95,300 tons, and paid $510,000 in dividends. For some time past distributions of $15,000 per month have been regularly paid, but it began to look as if this could not be continued. The improvement at 650 ft. has come just in time to save the situation.

George Ridgway, patentee of the Ridgway vacuum-filter, who is now part owner and manager of the Lancefield, 200 miles from here, appears to have at last got the treatment-plant into working order. During August 4660 tons was treated yielding $38,610, and a profit of $10,000; while in September the figures improved to 5448 tons, $46,950 and $15,000 respectively. The mine was formerly controlled by Messrs. Bewick, Moreing & Co., but, though it produced $4,580,000 from 573,000 tons, no dividends were ever earned, and the company collapsed with debts of $200,000. The ore-shoot in the three upper levels is 1200 ft. long and 25 ft. wide, but only returned $5 to $6 per ton. In the sulphide zone the grade is from $8 to $9, but, owing to the presence of arsenical pyrite, costs became prohibitive and extraction erratic, and the venture failed. After examining the mine in company with Richard Hamilton of the Great Boulder at Kalgoorlie, Mr. Ridgway was so satisfied with the mine that he invested his own money in the venture, overhauling and altering the mill. The ore developed is estimated at 250,000 tons worth $8.50 per ton, and this can be materially increased by continuing the drifts in the five lower levels for the full length of the ore-shoot. The deepest level is 1000 ft. on the underlay, which is very flat.

Recent diamond-drilling in the Ivanhoe at Kalgoorlie appears to confirm Malcolm MacLaren's prediction that the lode after passing through the porphyry dike would improve on entering the quartz-dolerite. The first hole cut the lode below the porphyry at a depth of 3457 ft. vertical, where it averaged $7.74 per ton over a width of 78 in.; the second hole reached the lode at 3482 ft. vertical, where it averaged $8.94 per ton and 39 in. The station at 3470 ft. has been made, and a cross-cut east started, so something more definite should be known before long. The sinking of the shaft is to be continued to the next level at 3620 ft., and this depth should be reached early next year.

According to the latest published estimates the ore reserves of the principal mines are as follows:

Name.	Short tons.	Value.	Life of mine, months.
Ivanhoe	1,010,240	$8.82	54
Lancefield	250,000	8.16	42
Menzies Consols	100,000	10.26	40
Horse-Shoe	814,280	7.76	36
Boulder	627,920	13.46	34
Perseverance	595,000	5.76	28
Lake View & Star	426,300	6.42	23
Edna May	60,000	21.08	20
South Kalgurli	165,100	6.12	17
Bullfinch	101,400	6.62	17
Oroya Links	168,600	5.86	14
Corinthian North	62,000	6.72	12
Kalgurli	130,000	...	12
Yuanmi	43,480	9.60	11

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

JUNEAU

October returns of the mines on Douglas island are as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Stamps working	120	540	270 (now 300)
Ore crushed, tons	19,075	82,593	46,018
Gold by amalgamation	$13,809	$80,358	$36,896
Gold by cyanidation	13,434	74,607	35,403
Total	$27,243	$154,965	$72,299
Average per ton	$1.43	$1.88	$1.56
Net profit after deducting construction	$295	$32,521	$4543*

*Loss.

On November 23, 1000 sq. ft. of the Alaska-Juneau wharf collapsed, dumping 150 tons of coal into the channel. Names of contractors for the new mill were given on page 814 of the last issue of this journal.

ARIZONA

GILA COUNTY

The Iron Cap shaft is down 900 ft., and a station is being cut. The October output was 179,847 lb. of copper, produced at a cost of 9.3c. per lb. The net profit was $15,065, and for six months $85,274.

Caving operations underground at the Inspiration mine are indicated by the openings near the Joe Bush shaft. The surface around this shaft is being prepared in anticipation of a collapse. A dump of ore containing 150,000 tons lying there is to be removed by raises driven up to the surface, and then drawing off the ore to the first level. The direct road between the Inspiration and Miami has been closed on account of the danger of caving. A 95-ton H. K. Porter Co. locomotive was received last week. It is of standard gauge, like the new cars being made. They will carry ore from the mine to the mill.

MARICOPA COUNTY

One of the oldest mining centres of Arizona is situated 15 miles west of Wickenburg, where the Vulture mine was located in 1863 by George Wickenburg. After many troubles an 80-stamp mill was erected in 1881, but the orebody faulted. The property was idle for 20 years, when a Boston syndicate secured control, found the ore-shoot, constructed a mill, and since 1910 has produced gold worth $100,000 per month. About 200 men are employed, and the property is one of the best gold mines in the State.

MOHAVE COUNTY

The new shaft of the United Eastern is down 30 ft. The south drift at 465 ft. is 120 ft. long.——At 505 ft. in the United Western the south-west cross-cut is in 50 feet.

In the Cedar Valley district the American Molybdenum Co. has erected a 25-ton test flotation-plant. At 70 ft. depth the ore contains from 2 to 25% molybdenum.

The property of J. W. Haas at Mineral Park has been sold to E. H. Smith of Phoenix for $50,000. A company will be formed to develop the 300 acres.

Owing to good results in developing a porphyry copper deposit at Mineral Park, a rush has set in to locate claims, and the country between Todd basin and Chloride is all staked. O. A. Turner is developing his deposit, and the ore averages 10% copper. The Copperfield Porphyry Copper Co.'s mine is estimated to contain 100,000 tons of 5% ore.

The United Basin Mining Co. has declared a dividend of 10%, equal to $85,000. Its Golconda zinc mine is employing 265 men.

Large dams are to be constructed at the mouth of Diamond canyon by J. B. Girand to hold water for power purposes. This county lacks cheap power, and this project will be a boon when completed.

YAVAPAI COUNTY

The Tip Top mine, near Prescott, has been a large silver producer, but examinations of its dumps, which contain 120,000 tons, reveal the fact that the waste contains 1.5% tungsten. Underground work has revealed shoots of wolframite, but little notice was taken of them. The present mill can produce 600 to 800 lb. of concentrate per day, but a larger plant has been ordered. Silver ore also remains in the mine and dumps as a chloride, but present efforts will be to recover the tungsten content.

The hübnerite discovery in the Eureka district is attracting attention. One shipment to Pittsburg, 3555 lb., was settled for at $1.60 per pound.

ARKANSAS

The high prices paid for zinc ore in the producing region of this State are said to be so attractive that farmers are taking to mining. This may result in a shortage of labor for farming.

CALIFORNIA

BUTTE COUNTY

The Forbestown Consolidated Mines property was sold last week by F. J. Stoer and Mrs. M. J. Cooney to C. W. Reece of Salt Lake City for $270,000. Payment extends to 1919. The claims are old producers, and are said to contain a large quantity of ore.

Five miles from Oroville the Butte Gold Mining Co. is preparing to resume extensive operations at its claims. A compressor, machine-drills, and 25-ton mill have been ordered. Los Angeles people are interested.

There is considerable activity at the South Banner.

A large amount of work has been done at the Robber's Roost mine at Nimshew, and returns from the gravel are good.

ELDORADO COUNTY

Supplies are being hauled to the Georgia Slide mine near Georgetown, which is bonded to R. E. Cranston and others of San Francisco. Preparations for extensive work are in hand.

INYO COUNTY

(Special Correspondence.)—The antimony mine of the Western Metals Co. at Wild Rose is shipping six tons of ore per day. Labor is done by Mexicans working on contract.

Production at the Skidoo Mines Co. has been interrupted by a scarcity of miners. The minimum wage is $4. The cyanide-plant is being completely housed and insulated with paper.

Skidoo, December 1.

NEVADA COUNTY

Following a preliminary statement of A. B. Foote of the North Star Mines Co., that certain wages were to be raised,

The managers of mines in the Grass Valley district held a conference, resulting in the announcement that the minimum wage of underground men was to be increased from $2.25 to $2.50 per day, and many receiving $2.50 will get $2.75. The companies agreeing are the North Star, Empire, and Golden Center.

The Mayflower mill is crushing ore again, having been closed for a long time. C. E. Brackett is in charge.

At the Golden Center the new hoist is working well. An increase of 10 stamps is contemplated, also a cyanide-plant. At a depth of 180 ft. below No. 7 level a rich shoot was cut last week.

Plumas County

The mill at the Engels copper mine has been doubled in capacity. On account of the road between Keddie on the Western Pacific, and the mine, haulage of supplies and concentrate is being done by teams instead of motor-trucks.

Sierra County

The new stamp-mill at the Oriental mine at Alleghany is working well, with plenty of ore in reserve. Two concentrators are part of the plant.

Tuolumne County

(Special Correspondence.)—The Black Oak mine and mill are working steadily with a full force. Pockets are being put in the main shaft at No. 18 level, which is 1640 ft. from the surface. From this level a cross-cut has been driven to the west, and a drift driven north 130 ft., in which distance some good ore has been encountered. It is necessary to extend this drift 75 ft. before cutting the main shoot. Winze No. 545, out 545 ft. from shaft, from No. 10 level south is down 70 ft. The vein shows 27 in. of $27 ore. On same shoot, No. 13 level south, raise No. 520 is up 150 ft., leaving 100 ft. to excavate to connect winze and raise. The top of the raise shows 4 ft. of $8 ore. All work in south part of mine is in virgin ground, and indications unmistakably ensure that the production will equal that of the north portion.

The Black Warrior mine, a location of 1856, situated on the Longeway ranch, six miles east of Sonora, is being worked by its owners, J. F. Burns and Albert Lund. Free-milling ore is being stoped from the face of a 300-ft. adit, where the vein is 8 ft. wide, and crushed in a two-stamp mill. The owners are making better than wages.

The Monarch Gravel Mining Co., recently incorporated, has taken over a 40-acre gravel claim on the south fork of the Stanislaus river, and an option on 289 acres of land adjoining. A 900-ft. adit has been run on the claim to cut the ancient river channel, the bench gravel of which has been exposed. According to borings the adit must be driven 300 ft. farther to intersect the channel. The claim contains an immense deposit of rhyolite tuff, or pipe-clay, which is now being tested by a San Francisco pottery firm.

E. J. and T. J. Conde and Jos. Oneto have bottomed an ancient channel by means of a 60-ft. shaft, five miles east of Sonora. They found 11 ft. of gravel resting on the bed-rock which gives a coarse gold prospect of encouraging value. Drifts are being driven to determine the extent and value of the gravel.

The company owning the Delmonte mine at Groveland has a representative on the ground making preliminary arrangements for the resumption of operations.

Lessees at the Knox & Boyle mine, embraced within the holdings of the Santa Ysabel Co., are making good. Lessees on the Jumper mine have cleaned up over $100,000 in the past year.

The pump-line is being extended in the Dutch mine, and development work is being pushed vigorously. The App to the south and the Sweeney to the north, two mines included in the recent bond given W. J. Loring, will be explored by drifts run from the Dutch shaft.

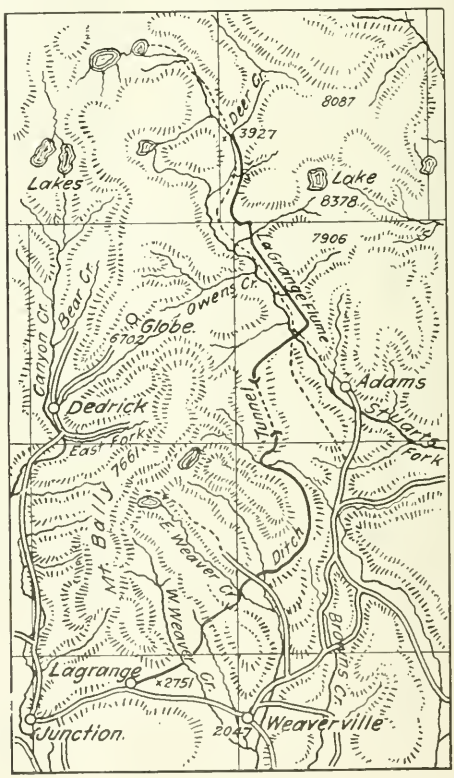
Sonora, November 29.

The Hope 'pocket' mine, near Sonora, yielded nearly $30,000 last month. A lower adit is in 800 ft. to cut the old Tainter shoot, a rich producer. The mine has an air-compressor, machine-drills, and five stamps. G. W. Weston is in charge.

Trinity County

(Special Correspondence.)—An examination of the Globe Consolidated mine, near Dedrick, is being made by San Francisco people who have recently become interested in the company. It is stated more aggressive development work will be commenced, and that improvements may be made to the plant in the spring. The mine has been developed by six adits, and good ore opened. Equipment includes a 20-stamp all-sliming mill, power-plant, and complete mine plant. The mine has produced about $250,000.

The hydraulic mining companies in the Weaverville district



Scale: 1 inch = 4 miles.

MAP SHOWING LAGRANGE WATER SYSTEM, TRINITY COUNTY, CALIFORNIA.

are busily preparing for operations. Late storms piled snow high in the mountains and an abundance of water will soon be available. Flumes and ditches at the Hupp, Lagrange, Testy, and other large properties have been repaired, and large quantities of supplies shipped in.

Vigorous work has started at the Golden Jubilee mine, near Carrville, recently acquired by the California Extraction Co., of San Francisco, for $50,000. New ground will be developed all the winter, to be followed by erection of a plant using a special process for treatment of the base ore. Operations of the mill will be followed with keen interest by local mining

men, as the complex character of these ores has militated against successful working of several properties. Most of the orebodies are oxidized near the surface, but pass into a sulphide zone at varying depths. As many of the mines are within the National Forest, roasting of ores is prohibited because of possible damage to timber by fumes.

Ore ranging from $100 to $300 per ton has been cut in the Lappin mine, near Deadwood. The shoot is narrow, but strong. A new shaft is being sunk and small shipments made to the mill.

Weaverville, November 20.

COLORADO

Clear Creek County

(Special Correspondence.)—The Climax property on Columbia mountain is the scene of a rich discovery, 12 in. of gray copper having been uncovered that is worth $98 per ton in gold, silver, and lead. The shoot is 1450 ft. from the portal of the Learch adit. J. M. Calder of Denver is manager.

The Burroughs mine on Quartz hill is shipping a good deal of $40 gold ore, which is coming from a 5-ft. vein in the east drift run from the Newhouse adit, the shoot showing for a length of 70 ft. N. J. Pike is manager.

E. Mosher, leasing on the East Lake mine on Bellevue mountain, has purchased the interest of his partner, Sam Petrie, paying $5000 in cash. This lease is making $2000 per month net.

Five feet of gray copper ore has been cut on the 400-ft. level of the Oneida property at Freeland that is worth $20 per ton. The ore is under an old stope which yielded $600,000 many years ago. H. T. Rogers of Idaho Springs is manager.

Operations will be resumed at the Gambetta mine on Republican mountain. Development will be centred on the 100-ft. level where a 2-ft. body of 46% zinc is showing. Thos. W. Cunningham of Georgetown is manager.

The Pulaski property on Leavenworth mountain is being developed by W. H. Stevens of Georgetown, and early shipments are promised.

The Mazeppa group of claims on Democrat mountain has been taken over by Jos. T. Broad; development will be continued throughout the winter months.

Idaho Springs, November 22.

There is more work going on in the East Argentine district than for many years, and prospects are good.

Lake County (Leadville)

Owing to an accident at the Penrose shaft of the Down Town mine the motors were submerged, putting them out of commission for a few days. In October the pumps lifted 162,000,000 gallons.

Teller County (Cripple Creek)

The gold output of the district in November was as follows:

	Tons.	Average value.	Gross value.
Golden Cycle, Colorado City	37,500	$20.00	$750,000
Portland, Colorado Springs	11,000	21.50	236,500
Portland, Independence	16,100	3.01	48,461
Portland, Victor	11,400	2.50	28,500
Colburn, Ajax	1,330	6.00	7,980
Caley-J. J. Johnson	1,500	4.00	6,000
Smelters	4,000	55.00	220,000
Total	82,830	$15.66	$1,297,441

On December 20 the Vindicator Consolidated will pay an extra dividend of 3c. per share, equal to $45,000. The company shipped 14,000 tons of ore in November. Development continues very satisfactory.

On December 10 the Golden Cycle company paid its regular monthly dividend of 2c. per share, equal to $30,000.

The ore found in the Gold Sovereign mine last month is proving to be very important. The shoot is from 12 to 18 in. wide, and at the north end assays 266.5 oz., and at the south 11.48 oz. gold per ton. Reject ore shipped was worth $40 to $50.60 per ton. The lessees have opened a stope for 65 ft., with ore still in the face.

Twenty tons of ore from the A. Hickman & Co. lease on Block 160 of the Stratton estate contained 15 oz. per ton. This is the third consignment.

The Cresson company is still sending out guarded shipments of rich ore. On Thanksgiving Day, November 25, two boxcars filled with sacked ore were hauled out for delivery to the Golden Cycle mill.

The Isabella company in November is reported as having produced ore valued at $37,000.

San Miguel County

Concentrate shipments from Telluride for the past 11 months show a large increase over that period of 1914. The November output was as follows in cars:

Tomboy	49
Smuggler	24
Liberty Bell	19
Black Bear	17
Columbia Lease	1
Wagner Lease	1
Total	111

IDAHO

According to R. Macbeth, secretary of the Idaho State Mine Association, there is more activity in Idaho mining regions than ever before. Nearly every idle mine has been re-opened. Contiguous to Boise 100 men are employed, an increase of 900 over this time last year.

Blaine County

During October, the Wilbert company in the Dome district, made a profit of $5578 from the treatment of 1530 tons of 29% lead and 7.45 oz. silver ore. Mining cost $4.19, and treatment $2.25 per ton.

Shoshone County (Coeur d'Alene)

It is probable that the Tamarack & Custer and Ray-Jefferson companies, operating in the Nine-Mile district, will erect a joint 200-ton mill. The former company may declare a dividend of 10c. per share this month, equal to $200,000.

At 4268 ft. from the portal, and a vertical depth of 1400 ft., the vein at the Gertie mine at Burke was cut last week. A large flow of water accompanied the development.

In the Alameda *v.* Success suit for alleged trespassing and wrongful extraction of ore, Judge Woods decided in favor of the plaintiff. The case attracted considerable interest.

MICHIGAN

The Copper Country

The copper output in November was about 25,000,000 lb. The various railways were busy hauling ore all the month, the Mineral Range, Copper Range, and Calumet & Hecla roads breaking records. The Mineral Range line has leased 50 large steel ore-cars from the Duluth, South Shore & Atlantic road, used in carrying iron ore. The Mineral Range hauls ore from over a dozen mines.

MISSOURI

Jasper County

A suit is pending in the Court wherein some hand-jigging syndicates are being sued by farmers who allege that the residue is covering their land.

MONTANA

Lewis and Clark County

There are 200 men working in the Scratch Gravel district. ——The Head mine produced 250 tons in October, but up to

500 tons is expected in November. New machinery has been erected.——Work has been started by J. H. Rowand at the Conrad silver mine, adjoining the Franklin of the Cruse estate.——The Scratch Gravel Gold Mining Co. is producing $2000 per day with 40 men. Above the 200-ft. level there is estimated to be ore worth $1,400,000. The mine is three miles from Helena. W. E. Cullen of Spokane is president.

Silverbow County

Now that the Anaconda company has complete control of the Alice property, it has started overhauling and unwatering with 25 men. The shaft has caved badly. The ore contains zinc and silver. At the Nettie mine the company has unwatered and repaired to 450 ft. At 2200 ft. in its Badger State mine the company has opened a fine body of copper glance.

It is probable that the Butte & Bacorn Copper Co. will be re-organized at Pittsburg. Prospects of the mine being a good zinc producer are considered bright.

NEVADA

Esmeralda County

The Pioneer Consolidated has issued a report in which it is stated that there is a large quantity of good ore opened, and recent development has been very encouraging. The mill is treating ore from three levels. Leasing has been started, the royalty being 10% on all ore less than $50 per ton; 15% from $50 to $75; 20% from $75 to $100, and 25% over $100 per ton. Experiments are being made in flotation. At a depth of 170 ft. a 24-in. vein has been cut assaying $111 per ton.

The Jumbo Extension's Velvet shaft is down 700 ft. The daily output is over 100 tons of ore of good grade.

The Atlanta is sinking through $30 to $35 ore. Improvement is reported from the 1750 ft. level.

The Goldfield Consolidated reports as follows for November:

Ore treated, tons	32,100
Gold extracted	$199,800
Expenses	147,000
Profit	52,800

Humboldt County

An explosion of gasoline resulted in the destruction by fire of the Nevada Short Line round-house and machine-shop at Nenzel. The Rochester Mines Co. reports its silver production for six months ended September 30 as 482,170 oz. In October the mill produced 62,000 oz. and $14,000 gold.

On December 1 the Seven Troughs Coalition company distributed 2½c. per share, equal to $37,500. An extra dividend may be paid for Christmas.

The tungsten mill of the St. Anthony company at Toy is to be enlarged. A high-grade concentrate is made.

Lincoln County

On December 31 the Prince Consolidated at Pioche will pay 5c. per share, equal to $50,000. The daily shipment to Utah smelters is over 350 tons of $7.50 to $10 iron-lead-silver ore. Monthly profits are more than $12,000.

Mineral County

The Eagle Mining Co., at Eagleville, reports that it has settled with the Western Ore Purchasing Co. for 15.5 dry tons of ore assaying 5.63 oz. gold and 3.28 oz. silver per ton, equal to $114.04 per ton gross.

Nye County

At Round Mountain, by allowing its pipe-line to fill with water in 85 minutes, the company is able to sluice for 25 minutes, but when colder weather sets in hydraulicking will cease until spring.

Tonopah mines produced 9747 tons of ore worth $201,406 during the week ended December 4. Development in all of the principal properties continues very gratifying.

White Pine County

The Independent Tungsten Mining Co. has been organized by Duncan MacVichie, W. Armstrong, and T. Giles, of Salt Lake City, and A. D. Myers, W. J. Stewart, and K. C. Davis, of Ely, to develop the scheelite claims located by Myers, Stewart, Davis, and Gaby, just south of Osceola. A mill has been ordered to treat the ore.

A plant to treat 24 tons of scheelite and hübnerite per day is being erected at the Sims-Olsen mine in Spring valley. The ore is mined by open-cut, is wide, and averages 2.5% tungsten. Los Angeles people are in control.

NEW MEXICO

Dona Ana County

(Special Correspondence.)—The Victoria Mining & Smelting Co.'s silver-lead property has been bought by C. T. Boyd of Los Angeles, at sale ordered by the United States district court to satisfy bankruptcy proceedings. The claims comprise about 1000 acres of mineral lands in two groups 20 miles apart, the southern between Organ and San Andres mountains, and the northern in the Plomo district of the San Andres, about 35 miles north-east of Las Cruces. The new owner will start extensive exploration at once. The property contains immense bodies of lead ore of milling grade.

Las Cruces, November 27.

OKLAHOMA

Ottawa County

The Picher Lead Co. has commenced construction on its second 300-ton mill at Picher. It will be driven by electricity.

OREGON

Baker County

A contract was recently let by M. Costello for the driving of several hundred feet in a gravel deposit near Sumpter. This will be part of a new system of mining this material which has been sluiced for some years. F. A. Cowing of San Francisco has an option on the property.

No. 2 dredge of the Powder River company is working just below Sumpter.

The Ben Harrison mine, in the Greenhorn district, has been closed for the winter. Flotation may be used in the mill next spring. Walter Fellows is manager.

SOUTH DAKOTA

Lawrence County

The following notice has been posted at the Homestake mine by the superintendent, Richard Blackstone: "The Homestake Mining Co. will pay to all employees whose names are on the December 1915 pay-roll, additional wages amounting to 7% of the year's salary for 1915. Check for same will be given out on the January pay-days."

Some renewed interest is being taken in the old Germania district, which was a busy place 30 years ago. Prospects are considered encouraging. The Safe Investment, Myrtle, and Lucky Strike mines had a good deal of money spent on them.

UTAH

Piute County

There are 150 men working at the Mineral Products Co.'s mine and potash plant at Marysvale.

Salt Lake County

During November the Salt Lake Stock Exchange traded in 1,335,668 shares valued at $349,693, an increase of $109,662 over that of October.

The Utah Metal & Tunnel Co. has taken over the Bingham New Haven property at Bingham. Shipments are at the rate of 110 to 200 tons per day, respectively. The consolidation will result in better work for both properties. E. P. Jennings and W. H. Barnes manage the Utah, and C. H. Doolittle the Bingham.

The weather has interfered with work in the Alta district,

and ore shipments are almost suspended, although plenty is ready to send out.

SUMMIT COUNTY

The well-known Ontario silver mine at Park City is to be developed on a large scale. There is a good deal of lead-silver ore at 1000 and 1500 ft. A new electric pump will be installed at 1500 ft. in a week or so. There is plenty of ore below this level. Water has been a great drawback. Old stope filling is estimated at 750,000 tons of fair-grade ore. From the old extensive workings the past output is said to be $50,000,000 in silver, lead, and gold, from which $15,000,000 was paid in dividends.

Park City mines shipped a total of 5855 tons of ore in November, making 96,223 tons in 11 months.

The Snake Creek tunnel was extended 360 ft. last month, the heading being at 13,600 ft. The flow of water is 900 gal. per minute.

In addition to its quarterly dividend of 25c. per share, the Daly-Judge is distributing 10c. extra, a total of $105,000. The mine is in excellent condition.

WASHINGTON

STEVENS COUNTY

(Special Correspondence.)—Forty miles north of Spokane the Lafayette Tungsten Co. is operating its property, producing a carload of product every two weeks. This is sent to an electric smelter at Tacoma and converted into ferro-tungsten. A small mill is working at the mine. The head office is at Railway Exchange building, Seattle, with W. H. Lowe as president, and G. Lafayette Loope, vice-president and general manager.

Seattle, December 3.

CANADA

BRITISH COLUMBIA

Dividends paid by provincial mines this year are as follows:

	1915.	1914.	Grand total.
Canadian Consolidated	$468,016	$468,016	$2,291,989
Granby	222,472	448,850	5,438,462
Hedley	300,000	300,000	1,823,520
Le Roi No. 2	59,600	.....	1,625,220
Standard	250,000	475,000	1,800,000
Rambler-Cariboo	35,000	.....	420,000
Total	$1,335,088	$1,691,866	$13,399,191

ONTARIO

The McKinley-Darragh-Savage mines are supplying the mill with 200 tons of ore daily, mostly from the first two. Ten machine-drills are at work underground. Development at 250 ft. is very satisfactory. There are 170 men employed in all. Dividends for 1915 are four of $67,431 each; the total to date being $4,404,459.

From the treatment of 28,600 tons of ore in November the Dome output was $160,000, in addition to $60,000 from the semi-annual clean-up.

YUKON

On November 5 the Canadian Klondyke company's steam-electric plant on Bear creek was destroyed by fire. The pumping-plant inside was surrounded by flames in short time, making it impossible to use it.

MEXICO

SONORA

On December 2 the Rodriguez forces occupied El Tigre. These men are devastating the whole country, and the destruction of the town is expected. They have destroyed 43 bridges between Nacozari and Esqueda. Officials and other employees of the Tigre Mining Co. arrived safely at Douglas. Rodriguez has split from Villa and is acting for himself. He stole 64 sacks of Tigre silver precipitate worth $300 per sack.

PERSONAL

ROSS B. HOFFMANN is at Petrograd.

P. B. MCDONALD is visiting Grass Valley.

PHILIP ARGALL is at Magdalena, New Mexico.

F. LYNWOOD GARRISON is near Tucson, Arizona.

WALTER BEAM, of Denver, is at the St. Francis.

C. W. PURINGTON has returned to London from Siberia.

H. M. PAYNE has returned to London from the Lena region, Siberia.

F. W. GUERNSEY has returned to Trail, B. C., from Thompson, Nevada.

CHARLES A. CHASE has changed his office to 812-824 Cooper Bdg., Denver.

JOHN A. AGNEW visited the Camp Bird mine, at Ouray, Colorado, this week.

NATHAN O. LAWTON, of Lawton, Michigan, will be at New York next week.

JOSEPH G. HIBBS, of Philadelphia, is examining chrome deposits in Del Norte county.

J. D. AUDLEY SMITH has changed his address to Dibbs Chambers, 58 Pitt street, Sydney.

E. E. CAMPBELL is superintendent of mines for the Granby Consolidated Co., at Anyox, B. C.

ANDRE P. GRIFFITHS, manager of the Dos Estrellas, at El Oro, has returned from Mexico to London.

ERNEST B. PEARCE is in charge of the new tin smelter of the A. S. & R. Co. at Newark, New Jersey.

JOHN W. MCKIM, recently with the Blane-Witkop zinc mines in the Transvaal, has returned to Salt Lake City.

W. W. JOHNSON, of the Union Construction Co., San Francisco, recently returned from a successful season in Alaska.

S. C. BULLOCK, formerly connected with the Poderosa Mining Co., Ltd., of Chile, has gone to England to offer his services to the Allies.

ROBERT NYE, of Grass Valley, has been appointed superintendent of the Lincoln Hill Milling & Mining Co.'s property at Rochester, Nevada.

GEORGE H. BARNHART has been appointed manager of the Wanakah Mining Co., Ouray, Colorado, in place of JOHN T. ROBERTS, JR., resigned.

E. K. SOPER, professor of mining at the University of Idaho, has returned to Moscow, Idaho, after several weeks spent in the Coeur d'Alene district, and will leave shortly for Butte.

G. D. HIRSCHBERG and M. N. ZINBERG, engineers on the staff of the Lenskoie (Lena Goldfields) company, in the Bodaibo district of Siberia, are here on a mission to purchase machinery.

W. A. WOLF has resigned his position with the Morococha Mining Co., at Morococha, Peru, to accept the position of mine captain with the South American Development Co., at Zaruma, in Ecuador.

MORTON WEBBER, who left his office at New York to fight with the Allies, has seen service in France (where he was wounded), then on the Gallipoli peninsula, and now "somewhere in the Balkans." He is a lieutenant in the Royal Field Artillery.

J. A. UDDEN, geologist of the Bureau of Economic Geology, University of Texas, has been appointed (October 6, 1915) director of the Bureau, the former director, WM. B. PHILLIPS, having resigned to become president of the Colorado School of Mines.

Some students and two professors from the University of Kansas at Lawrence recently visited the Joplin district, Missouri.

The Southern California section of the A. I. M. E. meets at the Sierra Madre Club on December 14. The feature of the evening will be a valuable paper by Robert T. Hill, of the U. S. Geological Survey, on the geology and mines of southern California.

THE METAL MARKET

METAL PRICES.

San Francisco, December 8.

	Cents per pound.
Antimony	40
Electrolytic copper	20.75
Pig lead	5.50—5.70
Quicksilver (per flask)	$115
Spelter	20
Tin	40
Zinc-dust, 100-kg. zinc-lined cases	30

ORE PRICES

San Francisco, December 8.

Antimony: 50% product, per unit	$ 2
Chrome: 52% chromic oxide and 2% silica per ton	12
Magnesite: plastic, no iron and lime, calcined, per ton	55
Magnesite: refractory, up to 7% iron, calcined, per ton	30-35
Manganese, 50% metal, 8% silica, per ton, f.o.b. cars, S. F.	12
Tungsten: minimum 65% WO_3, per unit for spot	$35—40

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 9.—Copper is dull and easy; lead is quiet, though firm; zinc is becoming firmer with more enquiry.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec. 2	55.50	Oct. 27	48.91
" 3	55.00	Nov. 3	49.37
" 4	55.00	" 10	50.02
" 5 Sunday		" 17	50.46
" 6	56.25	" 24	52.35
" 7	56.12	Dec. 1	56.27
" 8	55.37	" 8	55.54

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	51.88
June	56.43	49.03	Dec.	49.27	....

The silver market has been strong, with sudden movements. The count of metal held in London on November 12 showed only £750,000, against about twice that amount estimated. Indian Bazaars at once commenced buying, also China, along with the English and Continental transactions. The great rise in price followed.

On December 7 silver worth $264,193 left San Francisco for Shanghai. The Nipissing sent 248,306 oz. to London last week, and $393,307 since November 6.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Dec. 2	19.62	Oct. 27	17.79
" 3	19.62	Nov. 3	17.89
" 4	19.62	" 10	18.08
" 5 Sunday		" 17	18.58
" 6	19.62	" 24	19.58
" 7	19.62	Dec. 1	19.77
" 8	19.50	" 8	19.60

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.23	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	18.88
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended November 20 totaled 19,551,362 lb., valued at $3,609,790. England took 4,069,809; France, 7,318,141; Italy, 5,977,122; and Russia, 784,465 lb. Imports amounted to 6,860,191 lb., worth $1,118,474. Canada sent 1,685,046; Chile, 1,237,240; England, 1,826,698; and Peru, 2,002,694 pounds.

The copper production of Michigan in November was much the same as in October, namely, 25,000,000 lb. Calumet & Hecla has declared $15 per share, making $50 for 1915, against $10 in 1914.

United Verde has paid its fifth consecutive dividend of 75c. per share.

The Anaconda output in November was 24,100,000 pounds.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Dec. 2	17.50	Oct. 27	14.12
" 3	16.50	Nov. 3	14.92
" 4	16.00	" 10	15.63
" 5 Sunday		" 17	17.02
" 6	15.00	" 24	18.58
" 7	15.00	Dec. 1	18.52
" 8	15.00	" 8	15.83

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	17.20
June	4 84	22.20	Dec.	5.40	....

Buying of zinc ores at Joplin was lighter last week, and prices were $10 lower. The output of the region was 6816 tons blende, 442 tons calamine, and 1146 tons lead, averaging $91.54, $64.46, and $68.87 per ton, respectively. The total value was $731,235, and for 49 weeks, $23,571,403.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec. 2	5.25	Oct. 27	4.75
" 3	5.25	Nov. 3	4.87
" 4	5.25	" 10	5.02
" 5 Sunday		" 17	5.20
" 6	5.25	" 24	5.25
" 7	5.25	Dec. 1	5.25
" 8	5.25	" 8	5.25

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	5.15
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Date.		Nov. 24	105.00
Nov. 11	100.00	Dec. 1	105.00
" 17	100.00	" 8	115.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	58.00	92.90
May	39.00	75.00	Nov.	55.00	101.50
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	39.50
June	30.72	40.26	Dec.	33.60	....

Tin is firm at 37.20 to 37.50 cents.

ANTIMONY

Arrivals in New York will relieve the antimony situation at an early date, inasmuch as shipments are en route both by water from the Far East, and by rail from San Francisco. Meanwhile Chinese and Japanese grades are exceedingly scarce and the quotation is firm at around 40c. The demand is quiet.

ALUMINUM

The sole producer of aluminum, the Aluminum Company of America, is not making any open quotations, and states that it is out of the market, though it is taking care of its regular customers. Odd lots in the hands of dealers and brokers are quoted at 58 to 60c. for metal 98% pure. Less desirable grades are quoted at 57 to 59 cents.

Eastern Metal Market

New York, December 3.

The expected lull in the buying of metal has commenced. It is temporary; but just how long it will last no one can forecast. The London market, which New York has been following rather too closely, according to some people, is weaker. While copper is now quiet, quotations have remained firm, except for the offering of re-sale lots at concessions. Spelter prices have come down with a rush in a demoralized market, about the only feature of which has been pressure to sell. Second-hands show a tendency to shade the quotations for lead. Producers of both copper and lead are in a comfortable position, with plenty of business on their books. The November tin deliveries were small; the total visible supply showed an increase. The shortage in antimony will be relieved at an early date; meanwhile the high price holds. Aluminum is scarce, and practically all new business is confined to lots in the hands of dealers and brokers. Aluminum transmission wire is being sold for re-melting, in view of copper wire being much cheaper.

The shortage of ships is a serious question. At first, ocean-freight space was so difficult to obtain that exporters were chartering vessels. Now they cannot find the vessels to charter, and the foreign trade in metals, as in other products, is being restricted. Russia is doing a vast amount of purchasing in this country, especially in machinery, and is taking more machine-tools, for instance, than either England or France. Buying of finished iron and steel products is being done for deliveries in the third and last quarters of 1916, even though substantial premiums are asked by the mills. Export business in plates, shapes, and bars has been refused at over 2c. per pound. Steel billets for export have been sold at $42 per ton, Liverpool. Pig-iron is advancing, and inquiries are coming out for the second-half of next year. Practically every steel mill has extensions under way or contemplated.

COPPER

The lull in buying which was expected to follow the recent heavy movement is here. It was predicted in last week's report. Just before and just after the Thanksgiving Day holiday the market weakened a little, and quotations dropped to 19.75c. cash, for Lake, and 19.62c. for electrolytic, but there was a quick recovery and quotations mounted to 20 and 19.87c., for Lake and electrolytic, respectively. With the beginning of December, however, prices again declined to 19.75c. for electrolytic and 19.87c. for Lake. It is well understood that the producers are in a comfortable position with deliveries booked for months to come. They can merely look on for several weeks. The lower quotations are not due to any changed attitude on the part of the producers, but to a desire on the part of second-hands to induce business in order that they may realize profits, and to some extent they will achieve their object, as several consumers had made known their willingness to take more metal provided they could buy at ⅛ to ¼c. below the market. Small lots of Lake and electrolytic were offered December 3 at 19.50c. cash. Some good sales on foreign account are yet probable. Custom House returns show that the exports in November totaled 19,393 tons (exclusive of Southern and Pacific ports). Since January 1, 1915, they total 230,146 tons (exclusive of Southern and Pacific ports for November), against 338,063 tons in the same period of 1914. It will be noted that the November exports show a betterment. The London electrolytic market maintains a fairly strong tone. Spot was quoted December 2 at £99, and the 3rd at £98 10s. Figures cabled to the New York Metal Exchange show that the stocks of copper in England and France have continued to decrease. Stocks of all kinds in Great Britain on November 30 totaled 13,572 tons, against 15,473 tons on the 15th, and 18,410 tons on October 31. The stocks of fine copper in France on November 30 totaled 1473 tons, against 1645 tons on the 15th, and 1925 tons on October 31. Of the situation in refined copper, Henry R. Merton & Co., Ltd., London, said, under date of November 12: "The scarcity of freight-room from the States retards dealers here from offering any concessions, and it should be borne in mind that whatever the production of the metal there may be, the question of shipping facilities, or the lack of these, is a factor which is of considerable importance to buyers here." Much interest was aroused a few days ago by the publication in a New York newspaper of a story stating that the Germans had placed orders here for 200,000,000 lb. of copper for delivery after the War. The trade does not doubt that the Teutons have been heavy buyers in this market for later deliveries; in fact, that such purchases were being made was pointed out last spring. When the War started it was agreed that many millions of pounds which Germany had under contract would be held until deliveries could be made, and this, of course, meant after hostilities ceased. The Lake producers, reported a week ago as having withdrawn prices, did not long remain inactive.

Sheet-copper is quoted at about 25c., base. There is an enormous demand for seamless-drawn copper-tubing for the making of shell-rings. All of its makers have increased their facilities, and some firms are reported to have found a way to form the rings out of sheet-copper.

ZINC

In the latter part of last week the market became dull, and since then its bottom seems to have dropped out. Where prices advanced the day previous, they subsequently came down just as fast, or more so, with the result that spot prime Western, which was quoted December 1 at 18.12c., New York, and 18c., St. Louis, came down to 16.75 and 17c., New York, on December 3. January was about 15c. and first quarter of 1916 about 14.50c. The market was so demoralized that prices were not clearly defined, a situation due to offerings by speculators, and even consumers, who sought to dispose of their holdings before it became too late to realize profits. Sheet-zinc was quoted on December 3 at 22c. f.o.b. mill, carload lots. At one time the 8% discount allowed on carloads brought the price of sheets down to, or below, the quotation for zinc. Lower quotations for the metal will again bring the galvanizers into the market. The November exports reached the large total of 9123 tons. On the 30th spot spelter was held in London at £104, but the following day it fell £5 to £99. On December 3, spot at London dropped to £93.

LEAD

The trend in lead has been similar to that in copper. The producers, both large and small, are well sold up and can for a time let quotations stand at 5.25c., New York, 5.17 to 5.20c., St. Louis. These prices have been shaded slightly where it was sought to induce a sale, but on the whole the market has been firm, though dull. London shows a tendency to ease off, despite some important inquiries from Russia. The London quotation for spot on December 2 was £28 15s. Exports in November totaled 5423 tons.

TIN

The November deliveries into consumption were small, amounting to only 2975 tons, but this did not affect the market so adversely as the fact that the total visible supply had increased 3297 tons during the month. The market is dull, almost stagnant, and prices have declined. The spot quotation on December 1 was 39c., and on the 3rd it was 39c. also. The quantity now afloat is 8058 tons. Practically the only interest shown for days has been in small lots of spot tin whose purchase was prompted by necessity.

COMPANY REPORTS

NEVADA WONDER MINING CO.

The ninth annual report of this company, operating at Wonder, Churchill county, Nevada, covers the year ended September 30, 1915. The reports of J. A. Burgess and E. E. Carpenter, for the mine and mill respectively, include the following: Development amounted to 6053 ft., a total decrease of 5052 ft. compared with the previous term. A three-compartment inclined sub-shaft is now being sunk from the 1300-ft. level. A station is being cut at 1450 ft. to connect with workings done from a winze. The cost of mining was $4.16 per ton, a reduction of 49c. The mill treated 58,124 tons of ore, an increase of 9554 tons. The stamp-duty was 15.92 tons per day, or 18.1 tons for actual operating time. The recovery was 95.3% of the gold and 93.68% of the silver, resulting in a total of 9801 oz. gold and 1,123,398 oz. silver. This was an increased recovery of 0.91% in value. The total cost of treatment was $2.813 per ton. All costs amounted to $7.45 per ton, a decrease of $1.49. With cash on hand, $55,231; loans, $220,000, etc., the revenue totaled $561,124. Two dividends of 5% each absorbed $140,808. Cash at the end of September was $10,274.

LAKE VIEW & OROYA EXPLORATION, LTD.

This is an English holding company, having interests in companies operating in Australia, California, Central America, Colombia, and India. The profit for the year ended June 30, 1915, was $173,000, to which was added the previous balance of $120,000, making a total of $293,000. Two dividends absorbed $173,000. The technical committee, consisting of J. A. Agnew, Theodore J. Hoover, J. H. Cordner-James, and A. F. Kuehn, reported as follows on some of the companies:

Lake View & Star mine, Kalgoorlie, Western Australia: Reserves are estimated at 426,301 tons, averaging $6.43 per ton, a decrease of 66,029 tons. Work at 2100 ft. in the Lake View mine is encouraging, while in the Hannans Star mine work has been mainly in the upper portions, above 500 ft.; James shaft is down to 1300 ft. In the six months ended August 31, 1915, the mill treated 108,528 tons for a profit of $96,000. Dividends are equal to 16% on the capital.

Queen of the Hills: This mine is at Meekatharra, Western Australia. It is opened to 524 ft. On No. 5 level the shoot is 135 ft. long, being 59 in. wide, worth $8.30 per ton. Reserves are 37,453 tons of $7.86 ore. A profit of $72,000 resulted from the treatment of 44,055 tons in the year ended June 30, 1915. Sulphide ore is now being successfully treated.

Yuanmi: This mine is in the Murchison district, Western Australia. Down to 680 ft. reserves are 45,562 tons assaying $9.84 per ton. On No. 5 level the shoot is 300 ft. long, with 53 in. width, and $10.80 in value. During the year ended June 30, 1915, the net profit was $38,000 from 43,451 tons, sinking and development being heavy.

Zinc Corporation: This is the well-known company operating the South Blocks mine, a lead concentrating mill and flotation-plant at Broken Hill, New South Wales. The War has affected the scale of operations. Drilling on No. 7 level was very satisfactory, the lode being 40 ft. wide over a length of 350 ft. The mill treated 135,889 tons of ore yielding 27,362 tons of 66% lead concentrate. The flotation-plant is not working on account of the trouble of disposing of the product.

Burma Corporation: This company's property is in Burma, south-east India, where the principal work is at the Bawdwin mine. Ore reserves are 2,000,000 tons, assaying 25 oz. silver, 27% lead, and 22.5% zinc, a large increase. The 100-ton test-plant is busy determining a process. The smelter yielded an average of 1443 tons of hard lead per month. It is to be enlarged.

Central American Mines: This property is in Nicaragua. Owing to re-construction of the treatment plant a loss was shown in the last financial year, but profits are now being made. Anticipated profits are $7200 per month. The total length of ore on the second or lowest level is 1631 ft., worth $12.42 per ton. Reserves total 83,606 tons at $9.28 per ton.

Babilonia Gold Mines: Development shows considerable improvement, and reserves are 30,085 tons worth $9.60 per ton. The old and new plants yielded $105,000. With the new reduction-plant a monthly profit of $4800 is probable.

Granville Mining Co.: This concern controls the Canadian Klondyke Mining Co., now dredging near Dawson, Yukon territory. Up to September 25, the 1915 season's dredging has yielded 48,283 oz. of gold, against 53,775 oz. up to the same date of the year before. The falling off is accounted for not only by the loss of the use of one dredge, but also because of the necessary maneuvering of dredges through accumulated tailing. Next year's work is expected to give much better results. At the annual meeting of the North West Corporation, Ltd., held in July 1915, A. Chester Beatty, the chairman, stated that operations are progressing favorably, and that profits may soon be expected from the washing of gravel on this company's valuable property.

RECENT PUBLICATIONS

The Coal Fields of Kittitas County. By Edwin J. Saunders. Bulletin 9. P. 204. Ill., plans, maps, index. Washington Geological Survey, Olympia, 1914.

Accidents at Metallurgical Works in the United States, in 1913 and 1914. Compiled by Albert H. Fay. Technical Paper 124. P. 28. U. S. Bureau of Mines, Washington, D. C.

Report of the Sixth Annual Meeting of the Commission of Conservation of Canada, held at Ottawa, January 19-20, 1915. P. 333. Ill., photographs, plans, index. Ottawa, 1915. This is an interesting collection of papers on such subjects as minerals, non-metals, the mining industry, technical education, timber, water and water-power, forestry, fish, birds, town planning, etc.

The Peat Resources of Wisconsin. By Frederick William Huels. Bulletin 45. Economic Series 20. P. 274. Ill., maps, index. Wisconsin Geological and Natural History Survey. Madison, Wisconsin, 1915. Neither oil, gas, nor coal are found in this State, but scattered over the area are many marshy districts containing large deposits of peat, which must be used in time for fuel.

Influence of Temperature on the Strength of Concrete. By A. B. McDaniel. Bulletin 81. P. 24. Illustrated. Engineering Experiment Station, University of Illinois, Urbana, 1915. The results of the tests made under freezing temperature conditions are of especial interest, showing the gradual and slow gain in strength under a storage temperature slightly below freezing, and the disintegrating effect of alternate thawing and freezing temperatures. The bulletin will be of value to the contractor, engineer, and others engaged or interested in construction work, for information regarding the strength which may be expected of ordinary concrete under different age and temperature conditions and the time for the removal of the forms.

U. S. Geological Survey, Washington, D. C.:

Production of Magnesite in 1914. By Charles G. Yale and Hoyt S. Gale. P. 18. Map.

The Willow Creek District, Alaska. By Stephen R. Capps. Bulletin 607. P. 86. Ill., maps, index.

The Broad Pass Region, Alaska. By Fred H. Moffit, with sections on quaternary deposits, igneous rocks, and glaciation

by Joseph E. Pogue. Bulletin 608. P. 80. Ill., maps, index. Abstracts of these three publications will appear in another issue of the PRESS.

THE ELLAMAR DISTRICT, ALASKA. By S. R. Capps and B. L. Johnson. Bulletin 605. P. 125. Ill., maps, index.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA AND OREGON IN 1914. Mines report. By Charles G. Yale. P. 62.

THE MESOZOIC AND CENOZOIC ECHINODERMATA OF THE UNITED STATES. By William Bullock Clark and Mayville W. Twitchell. Monograph, Volume LIV. P. 341. 107 plates, index.

BOOK REVIEWS

EXAMPLES IN MAGNETISM. By F. E. Austin. P. 90. Ill., index. Hanover, New Hampshire, 1916. For sale by the MINING AND SCIENTIFIC PRESS. Price, $1.10.

Professor Austin is certainly prolific, as this is the fourth book of kindred subjects that we have reviewed recently. This one is for students in physics and engineering. The fundamentals of mechanics, solved examples, and how to apply the results in practice are given. The printing is in green ink, and is not too well done.

METALLURGY. By J. H. Stanshie. P. 151. Ill., index. J. & A. Churchill, London; P. Blakiston's Son & Co., Philadelphia, 1915. For sale by the MINING AND SCIENTIFIC PRESS. Price, $1.40.

The author of this elementary practical work for students and others is connected with several English technical institutions in England, and considers that many students only desire to get enough insight into the properties of the metals in which they are interested, therefore he prepared this book with that object in view, combined with sufficient scope for a course in general metallurgy extending over two years. It might be said that there is little new in the volume, excepting that useful laboratory courses can be arranged for each section of metal workers. The chapters include fuel, refractory materials, formation and reduction of oxides and sulphides, mechanical testing, non-ferrous metals and alloys, iron and steel, and gold and silver (19 pages).

METRO MANUAL. By the engineering staff of the Bausch & Lomb Optical Co. P. 200. Ill., index.

This attractive handbook is published by the Bausch & Lomb Optical Co. of Rochester, New York, and contains technical information regarding construction, adjustment, and use of transits, levels, etc. The firm of Bausch & Lomb has branches at New York, Chicago, Washington, and San Francisco, as well as at Frankfurt, Germany, and London. The handbook contains, besides the standard directions for adjustment and care of surveying instruments, a wealth of useful suggestions and information; for instance, a signal code for gradient work, time and latitude determinations, notes on mining surveys and shaft-plumbing, formulæ, and tables of weights, measures, conversion, etc. Tungsten-steel is used by this company for the making of magnetic needles, because tungsten is tough, strong, and para-magnetic. The problem of the collimation of the central horizontal cross-wire is here discussed fully for the first time. Also deserving mention are: methods of collimation for dumpy-levels; the effect of eccentric centres in transits; and a scientific treatment of the optical question.

ENGINEERING GEOLOGY. Second edition. By Heinrich Ries and Thomas L. Watson. P. 679. Ill., index. John Wiley & Sons, Inc., New York. For sale by the MINING AND SCIENTIFIC PRESS. Price, $4.

The authors are respectively Professor of Economic Geology in Cornell University, and Professor of Economic Geology in the University of Virginia and State Geologist of Virginia. Professor Ries is, of course, well known for his writings on clays and building-stones. This second edition of the book makes the total issue 4000. Only 40 pages are given to ore deposits, and 50 to historical geology. There is much on building-stone, clay, coal, petroleum, and limestone. The chapters on structural and dynamic geology are particularly good; folding and faulting of rocks in their relation to engineering operations, such as tunnelling, are timely points, the importance of which is often overlooked. The chapter on rock-forming minerals is clearly written for the purpose of aiding the engineer in his practical work, as is the portion devoted to rocks. In fact, the manner in which the entire treatment of geology in its different aspects has been kept to the purpose of serving the engineer is commendable. While the book has not been aimed particularly at mining engineers, it is unmistakably a valuable work for engineers in general, representing a maximum of practical knowledge in an interesting manner, with a minimum of inapplicable material.

MACHINE DESIGN. By Albert W. Smith and Guido H. Marx. P. 483. Ill., index. John Wiley & Sons, Inc., New York. For sale by the MINING AND SCIENTIFIC PRESS. Price, $3.

The authors are respectively director of Sibley College Cornell University, and professor of Machine Design in Leland Stanford Junior University. They say "One can never become a machine designer by studying books," and they quote John E. Sweet, who said, "It is comparatively easy to design a good new machine, but it is very hard to design a machine that will be good when it is old."

The present volume is the fourth edition revised and enlarged. Among the chapter headings are: cams; riveted joints; bolts and screws; sliding surfaces; axles, shafts, and spindles; journals, bearings, and lubrication; roller and ball-bearings; couplings and clutches; belts, ropes, brakes, and chains; fly-wheels and pulleys; toothed wheels or gears; springs.

The style is clear and thorough, with a sufficient number of tables, diagrams, and formulæ to make the matter inclusive, but not too many to get in each other's way; altogether a well-arranged treatise of a subject difficult to discuss in its entirety.

DIESEL ENGINES. Marine and Stationary. By A. H. Goldingham. P. 206. Ill., plan, index. Spon & Chamberlain, New York, 1915. For sale by the MINING AND SCIENTIFIC PRESS. Price, $3.

In the Palace of Machinery at the Panama-Pacific Exposition a 500-hp. Diesel engine, direct connected to a 250-kw. generator, was run for 10 months at a cost of 68 cents per hour. Crude California oil was used as fuel for this engine. Since 1892, when the late Rudolph Diesel invented this type of prime-mover, its use has spread to power-plants both on land and sea with success. There are now many manufacturers of Diesel engines, each claiming certain advantages for its particular patented improvements. In the United States there are eight works producing them. Their operation is becoming better understood, and when their low fuel consumption, labor, small area, and output are considered, the engine is without doubt highly efficient. Numerous papers have been prepared on the subject of the Diesel, but this is probably the first time that a practical treatise has been prepared of value to all grades of engineers. All existing literature has been studied and drawn upon, including leading engineering journals, and several well-known makers were consulted. The work is copiously illustrated, the author being able to secure drawings, photographs, and sectional views of nearly all the principal Diesel engines made. Indicator-cards from actual operation are given. The book is really worth while and students and engineers will find it easy to understand the details of construction, operation, and correction, and various types given.

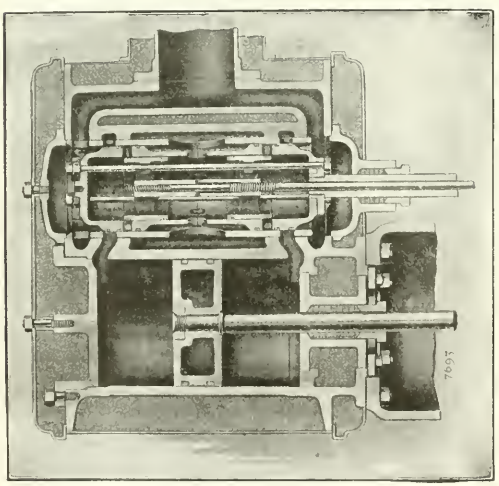
NEW MACHINES AND DEVICES

Information based on letters and catalogues from manufacturers.

Improved Valves for Steam-Driven Compressors

Present day steam-engineering practice is marked by the wider use of high pressure and superheated steam. This condition has made the use of the slide-valve gear, even of the adjustable cut-off type, obsolete practice on steam-driven air-compressors. The slide steam-valve in various forms has been standard on air-compressing units below the sizes (about 24-in. stroke) where the use of the Corliss valve-gear becomes commercially practicable. At high temperature the slide-valve is unsatisfactory, due to its tendency to warp, with consequent leakage. Under these conditions there is also an increasing difficulty of lubrication that results in greater wear and greater force required to drive the valve.

To provide a steam-driven air-compressor which will operate satisfactorily with high pressures and superheat, as well as at



SECTION THROUGH HIGH-PRESSURE STEAM-CYLINDER.

more moderate pressures, there has been developed and perfected a balanced piston steam-valve gear. This has been incorporated in the design of the standard Imperial duplex air-compressors of the Ingersoll-Rand Co., New York.

The use of the balanced valve, it is claimed, makes it possible to control the machine in the only really economical manner, by automatically varying the point of cut-off in the steam-cylinders. This method of regulation maintains constant speed for changing steam pressures and at the same time varies the speed of operation to the demand for air. Steam is always admitted to the steam-cylinder at full boiler pressure, and without the wire drawing of a governor of the throttling type, which means, briefly, that the machine automatically operates at its highest efficiency. It may be mentioned that the higher the steam pressure, the greater the relative increase in efficiency.

With the hand adjusted cut-off valves, usually set at $\frac{1}{8}$ or $\frac{3}{4}$ stroke, steam economy is admittedly poor, while with an automatic cut-off regulation the saving in actual steam consumption is the point most emphasized by the manufacturer.

This piston-valve is a perfectly balanced valve of the telescopic type. The cut-off valve is right and left hand threaded to a cut-off valve stem. Steam admission is through the centre of the valve, the steam passing through the valve-ports to the cylinder, and then being exhausted by the ends of the valve. It should be noted that this construction exposes the valve-chest covers and steam packings to exhaust pressure only, proportionately reducing the liability of leakage. The design and even distribution of metal in the Imperial piston-valve are claimed to preclude any possibility of warping, and to result in a valve so balanced that fraction is minimized and lubrication facilitated.

The steam ports are large and unusually direct, and special effort has been made to reduce the condensation surfaces in the cylinders. Exceptionally complete insulation, the separation of live and exhaust steam-passages, and the fact that the steam-chest partly encircles the cylinder contribute to the steam economy.

The unique steam receiver is a direct connection between high and low-pressure steam-chests. The low-pressure chest is proportioned to furnish additional capacity, and so located that the heat ordinarily lost by radiation is used in heating the cylinder and valve. A special expansion-joint prevents any possibility of cylinder alignment being destroyed.

The governor, automatic and giving close regulation, is a speed and pressure regulator which varies the cut-off by automatically rotating the cut-off valve-stem, and changing the relative position of the cut-off valves. It is a chain-driven rotary oil-pump which acts against a weighted plunger.

The compressor is built in capacities from 608 to 3620 cu. ft. per minute, and for discharge of air pressures from 10 to 110 lb. per square inch.

Commercial Paragraphs

Catalogue No. 12 of the DENVER QUARTZ MILL & CRUSHER CO., Denver, Colorado, contains a large amount of information and data on the well-known type of Chilean mill manufactured by this company. The convex roll running in a concave mortar is claimed to present many advantages over the ordinary type of mill.

Two pamphlets of the DEANE STEAM PUMP CO., Holyoke, Massachusetts, describe its horizontal, single-acting, triplex, portable mine-pumps (pot-valve pattern, 7 by 8 in.); its vertical triplex, pot-valve, outside-packed, plunger mine-station pumps (7 by 12 in.); and its high-pressure hydraulic-power pumps.

In flotation-oil circular No. 9 the PENSACOLA TAR & TURPENTINE CO., of Gull Point, Florida, discusses the rise in prices of pine products; also the subject of 'doped' oils, which many people do not know are sold as the pure product. No. 15, 75, 80, 350, and 1580 are considered good frothers, and ultimately will be used generally.

DENVER FIRE CLAY CO., Denver, Colorado, has published a circular descriptive of the 'Case improved crusher.' The crusher is designed to meet the constantly increasing demand for a strong laboratory ore-crusher, with special emphasis upon its capacity. The folder is illustrated and describes the features and improvements of this new type.

EDITORIAL

T. A. RICKARD, Editor

THE COST of living is increasing; so is the chance of making a living.

FORD and his party have been called 'cranks.' That is an honorable term: the cranks move the machinery of life. The people on the Oscar II are 'self-starters.'

DIAMOND mines in South Africa are to start on January 1, to be operated on a limited scale. This refers particularly to the De Beers, Jagersfontein, and Premier mines.

NOTICE is given by the United States Geological Survey that it is not equipped for making assays or analyses of rocks, its laboratory being overloaded with official work.

SILVER is the basis for international finance between Peking and London, just as gold is between New York and London. Dealers in exchange between Europe and the Far East buy or sell silver as a hedge against their operations.

PERU has adopted the mineral export tax, the bill authorizing the new duties having been passed on November 14. As finally adopted the tax represents a compromise between the demands of the Government and the protests of the mining interests. On metallic copper the export duty is 15 shillings per metric ton when copper is quoted at £60 in London, increasing 2s. per ton for each £1 increase in the quotation.

LOCATION of mining claims is discussed in a timely article by Mr. L. F. S. Holland in this issue. He gives numerous authentic examples of the interpretation of the apex law and the extra-lateral right associated therewith. As the end of the year marks a time of particular activity in the re-location of claims, the information should prove useful. Moreover the eccentricities of judicial decision are suggested in a manner apropos of the effort now being made at Washington to obtain a revision of the law.

COBALT, the use of which is being urged in Canada for the coinage of 5-cent pieces, has a specific gravity of 8.5, which is almost the same as that of nickel. The American 'nickel,' however, is composed of 75% copper and only 25% nickel. Undoubtedly Canada's diminutive silver 5-cent piece is a nuisance. In Germany the lack of metals has caused the Government to issue subsidiary coins made from open-hearth steel. We are informed that recent researches at Queen's University, in Ontario, indicate the possibility of substituting cobalt for nickel in electro-plating. Necessity is the mother of invention; war is the parent of necessity and of other tough progeny.

THAT statement about German buying of copper to the tune of 200,000,000 pounds, for delivery after the War, went the rounds of the daily press without contradiction. We understand that most of the metal agencies have sold copper to Germany for delivery when the trade-route is open again. Some of the copper bought by Germans at low figures early in the War has been re-sold at New York on the advance in price.

MEXICAN affairs are progressing in the right direction. According to the latest advices Maximo Garcia and five other generals of the Villa party have surrendered. Rodriguez and his band have been scattered, many surrendering. Villa's opposition is now negligible. Conditions in the North are improving as the Carranza government extends its control in the wake of the retreating forces of insurrection. Operations have been resumed at Cananea.

COPPER concentration at the Braden mine in Chile is the subject of an article abstracted by us in this issue from the little magazine recently started by the staff of the Braden Copper Company. This interesting publication is called *Teniente Topics* in memory of the *teniente* or Spanish lieutenant who, while escaping from the Argentine into Chile, discovered the first copper vein in the locality and thus was the pioneer of the big operations started in 1906 by Mr. William Braden.

FROZEN ground is an obstacle to placer mining in Siberia, as in the Yukon and Alaska. We give an account of the rudimentary method employed in Russia, where the 'steam-point' is not in general use. The use of hot stones reminds one of the hot iron used in a Russian *samovar* to heat water for tea. Even in the great alluvial operations of the Lena Goldfields the aid of steam in overcoming the perennial frost has only been adopted during recent years, to a minor extent. We are aware that a supply of 'steam-points' is now being purchased for this purpose in San Francisco and Seattle.

RIVALRY between copper and aluminum has been averted by the extraordinary rise in the price of the latter metal, for which 60 cents is now being asked. Indeed, the market for aluminum has risen so greatly as to warrant the dismantling of transmission lines in order to sell the metal. For instance, the aluminum wire of

the Reno Power, Light & Water Company, which serves Virginia City, Nevada, has been removed and sent to San Francisco for shipment to England. In this case the strands were 78 miles long and had been in use 11 years. At the time the line was erected the aluminum cost 32 cents per foot; now it is worth 48 cents per foot. Thefts of aluminum wire indicate its increment of value during the War.

AN action brought by the Goldfield Consolidated Mines Company against the Collector of Internal Revenue to recover $91,890, the amount paid in income-tax in 1909 and 1910, was dismissed on December 1 by the United States District Court in San Francisco. The suit was brought on the ground that the ore taken out of the mine should have been deducted from income, because the removal of the ore depreciated the company's capital and was equivalent to an operating expense. We are glad suit was brought, but action was taken too late. When the first dividend was paid, it should have been claimed as return of capital, until all the original capital had been returned to the shareholders. Now that this splendid mine has amortized its entire capital, the argument has been weakened. Of course, the dividends paid by a mining company are not income until the capital has been redeemed, for a mine is a wasting asset and has no goodwill when it is exhausted. But these are points rarely recognized when a mining enterprise is being incubated.

KNOWLEDGE of geography has been stimulated by the War. Most of us have obtained a better idea of relative distances and international boundaries since the organized calamity began. For instance, Archangel, on the White Sea, has come into prominence as a Russian port of entry since the Baltic was closed by the German fleet and the placing of mines in the Danish straits. But Archangel, despite the use of ice-breakers, is not open throughout the winter, so that an effort has been made to find other means of maritime communication with northern Russia. This has been effected by the construction of a railway to Katerina, in the estuary of the Luta river, on the coast of Lapland. The port of Katerina, or Ekaterina, is free of standing ice all the year round and the danger from Arctic ice-floes is to be minimized by the service of a wireless-telegraphic station. Mining operations in Siberia and the travel of engineers connected with Anglo-American enterprises there will be facilitated by the opening of the new route. Recently they have had to go by way of Tornea, at the head of the Gulf of Bothnia, and earlier in the War by the crossing from Stockholm to Rauma in Finland.

INCOME-TAX and other restrictions due to the War are likely to affect that part of the world's mining business that heretofore has been administered from London. English companies are now under decided disadvantages, some of them so marked as to prompt a change of registry. Those operating in Canada are hastening to place themselves upon the Canadian register. Similar changes are likely to be made in the case of Anglo-American enterprises, for the new income-tax will seem, to anybody but the most patriotic Britisher, an imposition without adequate recompense. Moreover, the scarcity of money for the purpose of mining and the embargo placed by the Treasury on new issues of capital will join in rendering London unpopular to mine operators. Unless, however, the American speculator or investor puts his money into foreign ventures, and on a big scale, it is probable that London will regain most of its ascendancy as a financial centre when the War is over. It is not lack of money, but the opportunity for it and need of it for domestic industry, that has prevented New York from superseding London as a source of capital for mining in a worldwide way. That opportunity and that need will alike continue to exist, and check American exploitation in foreign countries.

The Alaskan Affair

Our esteemed contemporary on Manhattan island, in its interesting issue of the 4th instant, "gets off on the wrong foot" when it states that Mr. F. W. Bradley and his associates operating the Treadwell group were skeptical of the claims made by the Jackling group in regard to what could be done in low-grade gold-mining on the Perseverance-Gastineau lode and of the development of the Alaska Juneau as undertaken by themselves until they became "converted" by the results obtained by their neighbors. The question is not one merely of priority, it goes to the heart of the entire problem. Our readers ought to be well aware of the facts, for they were stated clearly in our issue of December 6, 1913. However, we have added so many new subscribers since that date that it is worth while to re-state the origin of the Juneau enterprise. After an enormous lode of low-grade ore in slate had been proved by the shallow workings of the Juneau, starting from surface in Silver Bow basin, it was planned, as early as 1899, to tap the lode by a low-level adit. This work was begun in 1909, but financial arrangements ensuring the completion of it were not made until August 1910, when Mr. Bradley entered into a contract with the Alaska Juneau company to drive the adit in return for a share-interest. In 1912 Mr. D. C. Jackling appeared on the scene, and looked into the prospects of the adjoining Perseverance property. Undoubtedly he was led to consider the big scheme of development since put into effect by the Alaska Gold Mines, which controls the Alaska Gastineau property, by reason of the work undertaken and the plans formulated by engineers so experienced and capable as Messrs. F. W. Bradley and J. H. Mackenzie. If Mr. Jackling and his associates were influenced by the initiative of "the Treadwell group" they were wise, for no amount of experience in copper suffices to solve the problems peculiar to gold mining. The dissemination of chalcocite in monzonite porphyry exhibits a degree of uniformity in strong contrast with the sporadic distribution of native gold in quartz veins traversing slate. In the Juneau-

Gastineau lode-channel the ore is confined to the quartz stringers, which, by themselves, assay $6 per ton in free gold. The slate traversed by these stringers is practically barren; and so are the meta-gabbro dikes that cross the lode. The gold-bearing solutions appear to have confined their impregnation to the quartz stringers; they did not enrich the enclosing rock sufficiently to render it valuable to the miner. The deposit, as a mine, must be interpreted in terms of the gold in these quartz stringers. The original claim of a $1.50 average, made by the promoters of the Alaska Gold Mines, means mining a width of lode containing 25% of quartz stringers. This can be done, but not at a cost of 75 cents per ton. By careful selection and sorting it is possible to send even $6 ore to the mill, but at a cost entirely prohibitive. It is also possible by indiscriminate mining of lode-matter and quartz stringers to ensure a very low cost per ton, but such mining would reduce the yield of gold so as to render a profit out of the question. On the other hand, during the first four years (1897-1901) of operations at the Juneau an average yield of $4.10 was obtained by sorting 4½ to 1. By selecting the best places and rough sorting in the ratio of 1.6 to 1 in the next nine years (1901-1910) an average of $1.45 was obtained. In a report issued last April, Messrs. Bradley and Mackenzie estimate that, after a given proportion of sorting, an average ore of about $2 per ton can be obtained and that the selection of the ore to this degree will prove the most economic, giving a profit of 70 cents to $1 per ton on a tonnage of 1,500,000 to 2,000,000 per annum. The lode widens in the Juneau to 900 feet, but the ore is largely confined to three widths or bands, which will be mined, leaving the intermediate portions to sustain the ground. Whether the different treatments of the problem, breaking to a $1.25 mill-ore in the one case and to $2 ore in the other, are due entirely to a difference of policy or are modified by a difference in the distribution of the ore within the lode is a question yet to be made clear.

In the same article our contemporary says that "when it is a matter of 50 years' life, a gross of less than 6½% is needed to yield 6% net, which is about the basis on which our great mines sell, whether they ought to or not." Evidently the *Engineering and Mining Journal* does not know whether 6% is, or is not, a sufficient yield from a gold mine. Yet the matter is of some importance to the profession, which is called upon to advise those that put their money into, or take it out of, mining property. As we have indicated, more than once, the yield of 6% on a 50 years' life would be satisfactory if there were any assurance as to the accuracy of that estimate of continuous production, but the fact is that the 50 years is the result of a calculation based on several uncertain factors, of which the most uncertain determines the strength of the whole chain of causation. It is not an assured fact, only a reasonable hope, for instance, that this particular mine in Alaska has a life of 50 years. At the present time of writing the original estimates of yield and cost have been so stultified as to render it quite uncertain what is to be the average grade of the ore to be milled, and until that is determined no estimate of tonnage, and therefore of life, is reliable. Here we see the basic error made by others besides our learned contemporary in ignoring the fact that all estimates of tonnage, yield, cost, and therefore profit, per ton, are approximations. Being only approximations, the business organized on them is subject to risk. This risk calls for a proportionate recompense. In short, risk is an essential part of mining; the proportion of risk involved in any particular case must be gauged by the engineer, and not until he has considered it carefully as a chief part of his problem is he in a position to state what should be the annual yield on the capital involved. Obviously 6½% per annum is too little on a mine the market-value of which, as indicated by the quotation of its shares, has had to be discounted by 50% within six months.

The Status of Flotation Litigation

Our readers will be awaiting with keen interest the decision of the District Court at Wilmington in the case of Minerals Separation *v.* Miami. This probably will be handed down by Judge Bradford before the end of the current month. The final judgment of the Supreme Court of the United States on the review of the decision given by the Court of Appeals in San Francisco in the Hyde case is expected in March. Meanwhile an explanation of the present position of the litigation is timely. It cannot be understood by the layman without a brief reference to the relative positions of the various courts involved in the protracted legal contest between Minerals Separation and those whom it charges with infringement of its patents.

Until about three years ago the United States judicial system, so far as general jurisdiction is concerned, consisted of three courts, the United States District Court, the United States Circuit Court, and the United States Supreme Court. In addition to these three branches there was also a United States Circuit Court of Appeals to which appeals were taken from the decisions of the United States District Court and the United States Circuit Court. The judges sitting in the United States Circuit Court of Appeals were judges of the United States Circuit Court, designated for the purpose of constituting the appeal court. In the course of time it was found that no advantage arose from the existence of two separate United States Courts of original jurisdiction. As above described, the system included two courts in which suits initiated, namely, the District Court and the Circuit Court, the District Court taking cognizance of admiralty and certain other classes of litigation, and the Circuit Court taking cognizance of the other matters arising under United States law. By a recent statute, passed about three years ago, the Circuit Court was abolished and all suits are now originally started in the District Court. From the decisions of the District Court appeal lies to the Circuit Court of Appeals, and in certain cases, may be reviewed by the Supreme Court of the United States.

The Hyde case, which is the suit involving the Butte & Superior company, was started prior to the enactment of the statute abolishing the United States Circuit Court, which at that time was the court of original jurisdiction in patent matters. This statute was enacted while the Hyde suit was pending before the Circuit Court and the passing of it merely had the effect of automatically transferring the case from the abolished United States Circuit Court to the United States District Court, the jurisdiction of which was enlarged to include all cases, as indicated.

In certain classes of litigation the defeated party has the privilege, as a matter of right, to appeal from the decision of the United States Circuit Court of Appeals to the United States Supreme Court, and in such cases the Supreme Court must, under the law, hear and decide the appeal. The volume of business before the Supreme Court, however, became so great, some years ago, that the right of appeal to the Supreme Court, in certain classes of cases, was abolished, patent cases being among those in which litigants no longer have any right of appeal to the Supreme Court. While in the class of cases mentioned the right of appeal has been taken away, the parties still may file a petition in the Supreme Court asking that it review the case, and the Supreme Court, upon inspecting the petition, may, according to its judgment, either review the case or refuse to do so. This petition to the Supreme Court is technically known as a petition for a writ of certiorari, the words signifying that the Supreme Court is asked to direct the lower court—in this instance the Circuit Court of Appeals—to transmit to the Supreme Court a certified copy of the record in order that the latter may review the case.

In patent cases it is quite exceptional for the Supreme Court to grant a writ of certiorari. The United States is divided into nine judicial circuits, each circuit having its distinct system of District Court and Circuit Court of Appeals. It is therefore possible, and it sometimes occurs, that a point is decided one way by the Circuit Court of Appeals of one circuit, and oppositely by the Circuit Court of Appeals of another circuit. In such cases the Supreme Court will always grant a writ of certiorari in order to harmonize the law in the different circuits, but in the absence of some such compelling reason it is quite exceptional for the Supreme Court to grant the petition for writ of certiorari. It is necessary that some exceptional circumstance shall exist. In the Hyde case, now before the Supreme Court, Minerals Separation represented that the decision of the United States Circuit Court of Appeals for the Ninth Circuit was at variance with the decisions made by the House of Lords and by the Privy Council of the British Empire in the suits brought by owners of the Elmore patents against Minerals Separation in one instance, and against the Sulphide Corporation in the other instance. If the Circuit Court of Appeals for the Ninth Circuit had arrived at a conclusion opposite to that of the British House of Lords and the Privy Council of the British Empire there might possibly have been some reason for the Supreme Court of the United States taking the matter under advisement, notwithstanding that the tribunals mentioned are in different countries, this by reason of a certain deference shown by the courts of each country for the decisions made by the courts of the other country. The word 'comity' is the legal term generally employed to designate the weight that one court attaches to decisions of another court, when the decisions are not strictly binding by reason of the superiority of one court to the other.

The Elmore litigation decided by the House of Lords and the Privy Council involved the question whether the operations of Minerals Separation constituted an infringement of Elmore's patents, the Elmore patents in issue being those covering what is generally termed the 'bulk-oil' process, in which immense quantities of oil are used and in which the formation of a froth does not figure. The British courts decided that the operations of Minerals Separation and its licensees do not infringe the Elmore patents. The position of the Miami in this matter is that there is absolutely no conflict between the decision of the Circuit Court of Appeals at San Francisco and the decision of the British courts. Counsel for Miami never maintained that the Elmore bulk-oil patents anticipated the frothing process or that they disclosed the frothing process, or even suggested it. On the contrary, they have maintained the opposite. Minerals Separation, in the Hyde and Miami cases, has made the contention that the Elmore bulk-oil principle was involved in processes disclosed in the Everson patent, the Criley & Everson publication, the Fryer Hill publication, the Froment patents, the Froment description, the Kirby patents, and the article in the *California Journal of Technology*. Miami maintains that the bulk-oil principle was not involved in any of these operations and that it was not involved in any process except that described by the Elmore brothers. The Court of Appeals at San Francisco took the same position, and this position is in strict accord with the decision of the British Courts. If the Court of Appeals at San Francisco had decided that the Minerals Separation patents were anticipated by the Elmore bulk-oil patents, then there would have been a distinct disagreement between that court and the British courts. But such was not the case. In order to weaken the defence, Minerals Separation endeavored to establish identity between the prior art processes cited by the defendant, and the Elmore bulk-oil process. Defendant denied such identity and maintained that the prior art processes were like the Minerals Separation processes and totally different from the Elmore bulk-oil process. It remains now for the Courts to decide. The decision in the Miami case will be appealed, of course, whatever way it goes, but it may not go beyond the Court of Appeals at Philadelphia, because writs *à certiorari* are not often granted. Meanwhile the decision of the Supreme Court in the Hyde case will not be without its influence on the appeal in the Miami case from the Wilmington court. If Minerals Separation loses, the flotation process may be freed from patent litigation—a consummation devoutly to be wished; if it wins, another series of suits is probable.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

A Launder-Sampler

The Editor:

Sir—I am enclosing sketch of a scheme I devised for taking launder-samples in the Suan mill, at Holkol, in Korea. This sampler gave us excellent results, about a dozen being placed in the mill, and I hope that a description will be of benefit to others.

A detailed description is hardly necessary, as the sketch indicates clearly the construction and mode of operation. In reality it amounts to a square slip-joint pipe, lacking one side, the outside dimensions of which are the same as the inside of the launder, the upper section being securely fastened to the launder, while the lower section slides freely on an oakum-packed joint. A section is removed from the bottom of the launder to allow the total pulp to drop through into the sample-tin. The draw-bar is fastened to one section, so as to facilitate removal.

We found no difficulty in placing these samplers while operating. When closed they made an absolutely tight joint; in operation, an accurately timed clean-cut sample is readily obtained for dilution and tonnage calculations.

H. B. Fields.

Holkol, Korea, October 6.

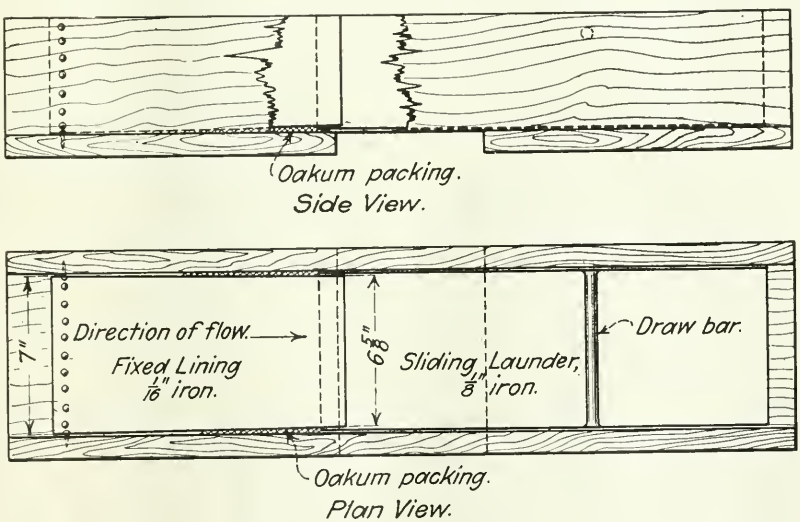
Classification and Fine Grinding

The Editor:

Sir—Under the above heading in your issue of October 16, Mr. A. E. Drucker seems to put the range limit for mechanical classifiers as –200 overflow product and a sand discharge.

In my own work I have had to call on the Dorr classifier to cover a much wider range, and have found it capable of easy adjustment to my needs. At the La Republica mine in old Mexico some eight years ago, a –100 overflow was required from a product made up of stamp-battery pulp (using a 20-mesh 0.023 wire) and tube-mill discharge. This was readily accomplished by using an adjustable baffle about 2 inches from, and parallel with, the back of the classifier. By raising or lowering this baffle, a wide range in overflow sizes can be obtained. In this case, I also used the front spray-pipe, and reduced the –200 product for the tube-mill to 1%.

By simple means I have always obtained classification very close to my needs below –100 overflow. A coarser overflow than this I have not needed to date, but know the division point can be readily and easily pushed up to coarser limits. Recently the same machine has been placed in extensive use for –48 and –60 overflows, returning oversize to the various ball-mills in common use.



In Mr. Drucker's absence abroad, this could easily have escaped his attention, as I recall no published accounts of this work.

Various plants can be cited using these machines, for example, the Anaconda Copper Mining Co. uses 52 simplex classifiers in closed circuit with Hardinge ball-mills, delivering a sandy product. The Inspiration Consolidated Copper Co. is using 18 large duplex classifiers, and is installing 18 more, delivering a −48 mesh product for treatment, and returning the oversize to large ball-mills. Many other mills have recently installed the same type of classifiers for delivery of coarse finished product.

The following is an actual screen-analysis of such work:

Mesh.	Screen size classifier sand.	Cumulative percentage classifier overflow.
On 28.....	32.2	0.0
On 48.....	71.2	0.64
On 65.....	84.9	5.89
On 100.....	91.5	14.89
On 150.....	94.4	....
On 200.....	95.7	....
Through 200.....	4.3	....

A. L. Blomfield.

Colorado Springs, November 29.

Who Owns A Report?

The Editor:

Sir—Discussion on the question of who owns an engineer's report has naturally brought out differences of opinion. I should say that the one for whom he makes a report, and who has paid for it, has the first claim upon it. But it does not follow that the information is locked up in an engineer's brain forever, not to be used by him at any future time. If for the purpose of estimating the value of a mine, the buyer or the seller, as the case may be, has the prior right to that for which he has paid. But after the occasion for which the report is made has passed, and he knows that no further negotiations are in progress, the engineer may use the knowledge so gained for another client, with perfect propriety.

The knowledge which years of experience brings, makes up a large part of the engineer's capital. The particular information of any one district which may be the sum-total of perhaps a dozen mine-examinations, entitles his opinion to special credence. If then he does not bring to bear all his knowledge, previously acquired, in the case of his latest examinations, he is not giving full value to his last client; and he is in no sense defrauding his client who paid him the first fee, for the report which covers perhaps the general features of the district.

A specific report belongs to the party who pays for it, but as only in rare instances does a mine remain in an unchanged condition, the subsequent reports on the same mine, made at later dates, must be treated as distinctive, even though the fundamental facts learned at the time of the first examination, remain the same.

A professional man's sense of the proper use of knowledge, will always guide him in utilizing what he has learned, over a period of years and by reason of the opportunities which possibly conflicting interests have given him.

In many instances an engineer has been open to criticism for leaving the employ of one company and devoting his acquired knowledge to the neighboring mine. In case there has been no conflict of interest, harmful results are avoided, but it demands a very strict interpretation of the ethics of the situation to "keep off the rocks."

It is axiomatic that the chance to acquire adjacent property belongs first to the operating company by whom an engineer is employed and all territory that by any possible interpretation may be advantageous to his employer is not the proper subject of speculation by any employee of the company.

Reports may be verbal as well as written and the dissemination of information, except by specific consent of the client, should be carefully avoided, even though it be at the risk of exposing an engineer to criticism as uncommunicative.

F. L. Sizer.

San Francisco, November 15.

The Editor:

Sir—This question, asked in your issue of October 30, is, at the first thought, very easily answered: the client. And this, too, is good professional usage. But along with this question there are an infinite number of "dips and angles" that call for a qualifying answer.

The average client is inclined to play fair with the engineer, but there are some who do not. The ownership and control of a report (and the knowledge that made the report) should revert to the engineer in the following cases: when his buying client has turned down a property or has failed after a reasonable length of time to show active interest in it; and when his investigating client, of a district or region, for example, has had a reasonable length of time in which to make use of the report. Complicated conditions necessarily arise which are not subject to any single rule or standard which can be laid down.

Generally, I believe, an understanding between client and engineer before the examination is made would solve the question of ownership more satisfactorily than any set of rules or standards possibly could. The older established engineers can take liberties when, under similar conditions, the younger engineers could not, hence the latter more often suffer an injustice. Finally, let the engineer use his reports and knowledge in such a way that his client will suffer no financial loss, or injury of any kind.

Corey C. Brayton.

San Francisco, November 28.

Quarrying has a death-rate of 1.72 per 1000 employed, against 3.54 in metal and 3.73 in coal mines. Contrasted with underground work, quarrying is much less hazardous. The chief sources of accidents in quarries are haulage, falls of ground, and explosives.

Extra-Lateral Right

By L. F. S. HOLLAND

Introduction. Much of the litigation under the United States mining law originates in the provisions of Section 2322, Revised Statutes of the United States, 1872, which allows the right of extra-lateral pursuit in their descent into the earth, and in the direction of their dip, of all veins apexing within a properly located claim.

While the United States Supreme Court, the final arbiter upon all questions arising under the Federal laws, has by no means established a precedent for the interpretation of the law in all conditions affecting extra-lateral right, certain principles have been fairly well established in various courts, and a digest of such decisions is here presented in the hope of affording some assistance to the locator and miner in protecting his rights.

Acknowledgements are made to Dr. Rossiter W. Raymond's contributions to the Transactions of the American Institute of Mining Engineers, volumes XII, XV, and XVII; 'Lindley on Mines,' 3rd edition; Costigan on 'Mining Law'; Shamel, 'Mining, Mineral and Geological Law'; Morrison and De Soto, 'Mining Rights,' 13th and 14th editions; and United States Bureau of Mines, 'Abstract of Current Decisions on Mines and Mining.' As these publications are commonly accessible to mining men, and are found in most public libraries, references are made to them here where possible, as well as to the usual law reports, which generally are found only in law libraries.

Preliminary Requirement. To allow of extra-lateral pursuit under the act of 1872 the vein or lode (1) must be "in place"; (2) it must have an apex; (3) it must be continuous and its identity must be preserved as a geological fact, though the fissure may be interrupted or nearly closed. In a properly located claim (a) the end-lines must be parallel, or at least not diverge in the direction of the dip of the discovery vein,[1] (b) the end-lines must be continuous and unbroken.[2] However, extra-lateral right attaches to irregularly-shaped locations that were made prior to the act of 1872.[3]

The Ideal Location. The highest type of a perfected location is described by Lindley as "a rectangular parallelogram, the lines crossing the apex of the lode at right angles to the general course of the vein, termed in law the end-lines, the extremities of which are equi-distant from the centre of the vein, the side-lines parallel to the course of the vein; that is, equi-distant throughout from a line drawn through the centre of the apex on its longitudinal course."[4] Under Section 2322 the extra-lateral right flowing from such a location is unquestioned, but unfortunately for the application of the law such conditions are rarely even approximated.

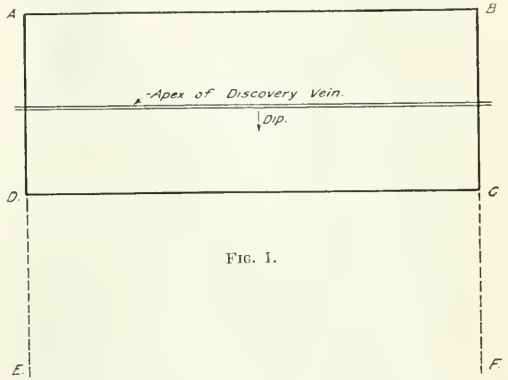


Fig. 1.

Fig. 1 represents the ideal location. The vein may be followed extra-laterally within vertical planes through the end-lined *AD*, *BC*, prolonged to any distance desired in the direction *E* and *F*.

Exception. A vein that is horizontal or does not descend from the horizon is a "blanket vein," and has no extra-lateral right, for the reason that the whole upper surface is really its apex strike, and to allow extra-lateral right would be to allow it on the strike of the vein. If, however, a vein descends from the plane of the horizon, though the angle be very slight, it departs "from a perpendicular" within the meaning of Section 2322.[5]

Anticlinal Vein. In a decision handed down in the Jim Butler *v.* West End case, by Judge Averill of Tonopah, Nevada, as recently as April 30, 1915, it was held that extra-lateral right extends downward from an anticlinal axis or common apex of a vein in a given claim beyond both side-lines of the claim. The case was discussed by H. V. Winchell in the Mining and Scientific Press of May 15, 1915.

[1]See Del Monte *v.* Last Chance, 171 U. S., 55; 18 Sup. Ct., 55, 895; 43 L. Ed., 72. Carson City *v.* North Star, 73 Fed., 597; 83 Fed., 658. Daggett *v.* Yreka, 149 Cal., 357; 86 Pac., 968, 974. McElligott *v.* Krogh, 151 Cal., 126; 90 Pac., 823, 827. Iron Silver *v.* Elgin, 6 Sup. Ct., 1177; 118 U. S., 196; Lindley Sections, 365-582; Costigan, p. 418; Raymond, Trans. A. I. M. E., XV, 272, XVII, 781; Shamel, 217; Morrison, 171.

[2]See Walrath *v.* Champion, 171 U. S., 293, 311; 18 Sup. Ct., 909; 43 L. Ed., 170; 19 Morrison's 'Mining Report,' 410; Lindley, 365; Costigan, 420.

[3]See Argonaut Co. *v.* Kennedy Co., 131 Cal., 15; 63 Pac., 148; 82 Am. St. Rep., 317; aff'd. in 189 U. S., 1.

[4]See Empire *v.* Tombstone, 100 Fed., 910, 913; 20 Morrison Mining Rep., 443; Lindley Sec., 360.

[5]See Leadville *v.* Fitzgerald (U. S.), 4 Morr. Min. Rep. (U. S.), 380; Fed. Cas. No. 8, 158. Stevens *v.* Williams (U. S.), Fed. Cas. No. 13,414. Homestead Mining Co., 29 Land Dec., Dept. Int., 689. Jack Pot Lode Mining Claim, 34 L. D., 470. Belligerent and other lodes, 35 L. D., 22; Lindley Sec. 583; Costigan, p. 414; Shamel, 233-236; Morrison, 170.

In Fig. 2, which is reproduced from Mr. Winchell's article, the arrows indicate the dip of the vein on either side of the anticlinal axis. The owner of the claim was held to have extra-lateral right in both direction. Judge Averill's decision may, or may not, be upheld in the higher courts.

Broad Vein on Both Sides of a Common Side-Line. The senior claim takes the entire width of the vein on its

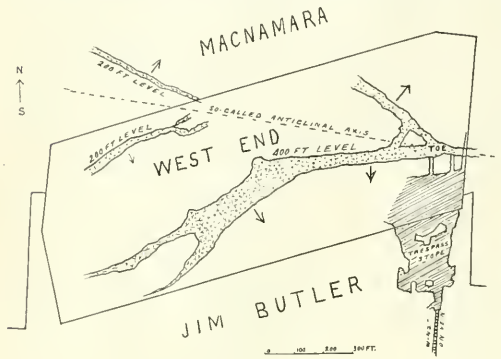


Fig. 2.

dip if the claim is in other respects so located as to give it extra-lateral right.

In Fig. 3 the Viola claim, being the senior location, takes all the ore between the extended end-lines *ADE*, *BCF*. The San Carlos gets no ore between these lines,

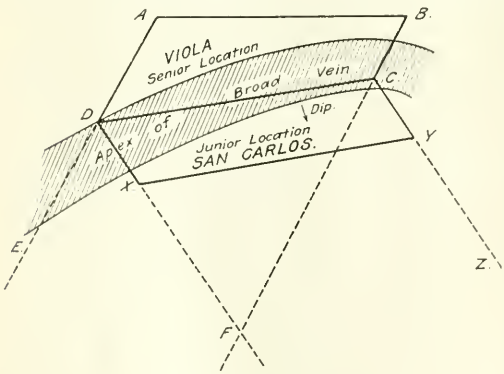


Fig. 3.

but is entitled to the ore between *FC*, *CZ*, which is outside of the limits of the senior location's extra-lateral right.[6]

Discovery-Vein Entering and Departing Through the Same Side-Line. The Supreme Court of Colorado has held that the Fulton claim, represented in Fig. 4, whose discovery-vein twice crossed one side-line, but did not cross either end-line, had no extra-lateral right. Some authorities doubt if this decision will be upheld should the question have to be considered by the United States Supreme Court. It may here be noted that a side-line need not be a straight line.[7]

Discovery-Vein Crossing Two Parallel Side-Lines. The extra-lateral right is in the direction of the dip of the vein and is determined by producing indefinitely the located side-lines in that direction. The located side-lines are treated as the legal end-lines and the located end-lines are treated as the legal side-lines. The angle at

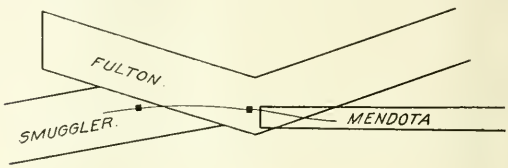


Fig. 4.

which the discovery vein crosses the located side-line is of no consequence to the extra-lateral right.

In Fig. 5 the Amy claim had no extra-lateral right on the north side of the located side-line *AB*, which became a statutory end-line, but the vein could be followed on its dip within the limits of the lines *ABE* and *DCF* produced indefinitely.[8]

Discovery-Vein Crossing Two Opposite Non-Parallel Side-Lines. While there is no requirement of the law that side-lines should be parallel, and there are no decisions to follow as precedents, it is probable that in

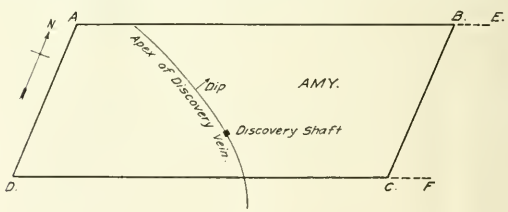


Fig. 5.

the case of non-parallelism of side-lines, the claim would be held to have no extra-lateral right if its side-lines diverge in the direction of the dip of the discovery-vein, but if they converge, the vein may be pursued in its downward course to the line of intersection of the two planes.[9]

Discovery-Vein Crossing One End-Line and a Side-Line. The law is now well settled that the extra-lateral right in this case is to the segment of the vein, through-

[6]See Empire State *v.* Bunker Hill & Sullivan, 114 Fed., 417, 419; 52 C. C. A., 219; 22 Morrison Min. Rep., 104. U. S. Mining Co. *v.* Lawson, 134 Fed., 769, 774; C. C. A., 587; Lindley, 583; Costigan, 437, 438; Shamel, 227-229.

[7]See Catron *v.* Old, 23 Cols., 433; 58 Am. St. Rep., 256; 48 Pac., 687; Lindley, 584; Costigan, 443; Shamel, 214; Morrison, 174.

[8]See King *v.* Amy-Silversmith M. Co., 152 U. S., 222; 14 Sup. Ct., 510. Flagstaff Co. *v.* Tarbet, 98 U. S., 463; 9 M. R., 607. Del Monte *v.* Last Chance, 171 U. S., 55, 89, 90; 18 Sup. Ct., 895, 908; 43 L. Ed., 72; Lindgren, 556, 589; Costigan, 422-425; Shamel, 202-207; Morrison, 159.

[9]See Lindley, 590; Shamel, 219.

out its entire depth, bounded by a vertical plane through the crossed end-line produced indefinitely in the direction of the dip, and a parallel plane through the point where the vein crosses the side-line.

In Fig. 6 the extra-lateral right of the New York claim is between the vertical plane *BCE* produced in-

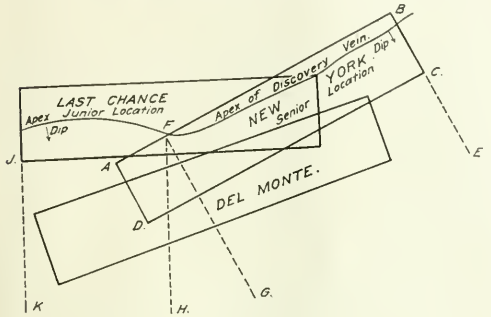


Fig. 6.

definitely in the direction of the dip of the discovery-vein, and the parallel plane *FG* through the point *F*, where the vein crosses the side-line *AB*.[10]

Discovery-Vein Crossing Three Boundary Lines of Claim. There is no right to any part of the vein, the apex of which part is outside of the claim.

In Fig. 7 the locator would have extra-lateral right

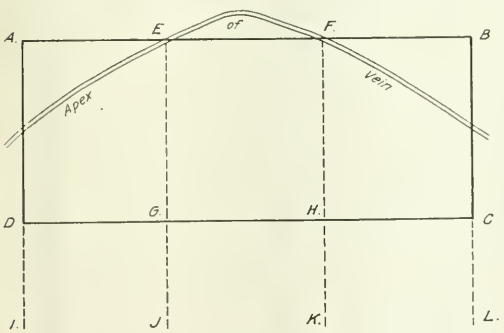


Fig. 7.

between the planes *ADI* and *EGJ*, and between the planes *BCL* and *FHK*, but not between *EGJ* and *FHK*.[11]

Discovery-Vein with Apex Wholly Within the Claim, Reaching No Boundary Line or Only One Boundary Line. While there appears to be no adjudicated case, the dicta in the Del Monte and Carson City cases affirm that extra-lateral right is preserved and is defined by planes through the terminations of the vein drawn parallel with the located or statutory end-lines, according to the parallelism of the vein.

Fig. 8 and 9 represent two of several situations falling within these conditions.[12]

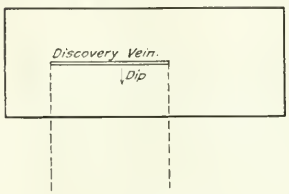


Fig. 8.

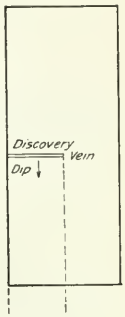


Fig. 9.

Secondary or Incidental Veins. The extra-lateral right as to all veins apexing in a claim is governed by the extra-lateral right of the discovery-vein and is defined by the same set of end-line planes as limit that right on the discovery-vein. Such planes are applied at the extremities of the secondary veins, parallel to the end-lines of the claim. If the discovery-vein has no extra-lateral right, the secondary veins have none. Furthermore, if the planes defining the extra-lateral right of the discovery-vein are parallel or coincident with the course of a secondary vein, there is no extra-lateral right on the secondary vein.[13]

Morrison states (13th edition, page 178; 14th ed., 203) that the decision in Ajax *v.* Hilkey (31 Colo., 131; 102 Am. St. Rep., 23; 72 Pac., 447; 22 Morrison Min. Rep., 585; 62 L. R. A., 555) is inconsistent with the other rulings cited, whereas Lindley says (Section 594, page 1394), "We think the decision in Ajax Mining Co. *v.* Hilkey states the correct rule." Costigan (page 443) agrees with Lindley.

In Fig. 10, representing the Victor Consolidated claim in the Ajax *v.* Hilkey case, the secondary vein had extra-lateral right between *EF* and *GH*, although the extra-lateral right of the discovery-vein was only between *AB* and *CD*. The ruling of the Court was that "Such rights

[10]See Del Monte *v.* Last Chance, 66 Fed., 212; 171 U. S., 56; 18 Sup. Ct., 895; 43 L. Ed., 72. Tyler *v.* Sweeney, 54 Fed., 285, 292; 4 C. C. A., 329; 61 Fed., 557. Clark *v.* Fitzgerald, 171 U. S., 92; 18 Sup. Ct., 941; 43 L. Ed., 87. Fitzgerald *v.* Clark, 17 Mont., 100; 42 Pac., 273; Lindley, 591; Costigan, 426; Shamel, 207-210; Morrison, 174.

[11]See Waterloo *v.* Doe, 82 Fed., 45, 55; 27 C. C. A., 50; 19 Morrison Min. Rep., 1; Lindley, 591 a; Costigan, 433.

[12]See Del Monte *v.* New York, 66 Fed., 212, 215. Carson City *v.* North Star, 73 Fed., 597; 83 Fed., 658; 171 U. S., 687. Tyler *v.* Sweeney, 54 Fed. 284, 293; 4 C. C. A., 329. Work Mining Co. *v.* Doctor-Jack Pot, 194 Fed., 620, 629. Cons. Wyoming *v.* Champion (c. c.), 63 Fed., 540, 549. Armstrong *v.* Lower, 6 Colo., 393. Wakeman *v.* Norton, 49 Pac., 283. San Miguel *v.* Bonner, 33 Colo., 207; Lindley, 592; Costigan, 427-428; Shamel, 210, 212.

[13]See Walrath *v.* Champion, 18 Sup. Ct., 909; 72 Fed., 978; 19 C. C. A., 323; 171 U. S., 293. Cosmopolitan *v.* Foote, 101 Fed., 518. St. Louis *v.* Montana, 104 Fed., 664. Jefferson *v.* Anchoria-Leland, 75 Pac., 1070; 32 Colo., 176; 64 L. R. A., 925. Fitzgerald *v.* Clark, 17 Mont., 100; 52 Am. St. Rep., 665; 42 Pac., 273; 30 L. R. A., 803, aff'd. in 171 U. S., 92; 18 Sup. Ct. Rep., 941; 42 L. ed., 87. Montana *v.* St. Louis, 183 Fed., 51, 61; 105 C. C. A., 343. Davis *v.* Shepherd, 31 Colo., 141. Work M. & M. Co. *v.* Doctor-Jack Pot, 149 Fed., 620; Lindley, 593; Costigan, 440; Shamel, 220-222; Morrison, 178.

as to secondary veins are not confined to such veins as apex within the same segment of the claim in which the apex of the discovery-vein exists; and while the end-lines of the location, as fixed and described in the patent,

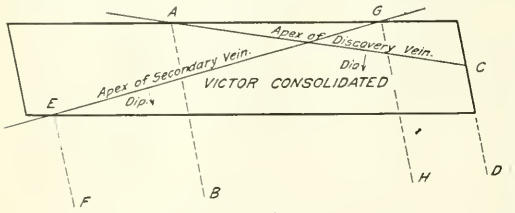


Fig 10.

are the end-lines of all veins apexing within the surface boundaries, and may constitute the bounding planes for such extra-lateral rights, and in no case can the locator pursue the vein on its dip outside the surface lines beyond such planes continued in their own direction until they intersect such veins, yet these bounding planes, which in all cases must be parallel to the end-lines, need not be coincident."[14]

Conflicting Surface Locations with End-Lines at Different Angles. After satisfying the extra-lateral right of the senior location, the junior location has the 'judicial apex' and is entitled to the part of the dip unlocated by the senior claim, within the segment bounded by the extended end-line planes of the junior claim. Lindley says (Section 594), "Construct extra-lateral right planes on the junior claim as if there were no conflict. Subtract the segment of the vein to which the senior is entitled. The remainder belongs to the junior claim." In Fig. 6 the New York claim's extra-lateral right is between the vertical planes *B C E* and *F G*. The extra-lateral right of the Last Chance claim is between *FG* and *JK*, which includes the segment *HFG* as well as *JK, FH*.[15]

Vein Dipping Under Senior Agricultural Grant. In the only reported case it was held that a vein cannot be followed on its dip through a prior agricultural grant.[16]

Practically all Latin-American and European countries employ the metric system of weights and measures. This makes difficulties and misunderstandings when business is conducted with firms in the United States and England where the English system is used.

[14]See Lindley, 594; Costigan, 441-443; Shamel, 223; Morrison 13th ed., 178, 14th ed., 203.

[15]See Lavagnino *v.* Uhlig, 198 U. S., 443; 25 Sup. Ct., 716; 49 L. Ed., 1119. Del Monte *v.* Last Chance, 171 U. S., 55, 85; 18 Sup. Ct., 895; 43 L. Ed., 72; 19 Morrison Min. Rep., 370. Bunker Hill & Sullivan *v.* Empire State, 108 Fed., 189; 109 Fed., 538, 547; 48 C. C. A., 665; 114 Fed., 420; 121 Fed., 973, 976; 58 C. C. A., 311; 22 Morrison Min. Rep., 560; 131 Fed., 591, 596; 66 C. C. A., 99; 200 U. S., 613, 617; 26 Sup. Ct. Rep., 754; 50 L. Ed., 620, 622; 134 Fed., 268, 270; Lindley, 596; Costigan, 434; Shamel, 238-240.

[16]See Amador Medean *v.* South Spring Hill (c. c.), 36 Fed., 668; Lindley Ses., 597; Costigan, p. 450.

Determination of Tungsten

These notes from 'Analysis, Detection, and Commercial Value of the Rare Metals,' by J. Ohly, are timely.

Detection. The presence of tungsten is readily ascertained by boiling the finely powdered mineral with a mixture of four parts of hydrochloric acid and one part nitric acid for about two hours in a porcelain dish, when, in case the ore contains tungsten, yellow spots of tungsten trioxide will be discernible. The trioxide is insoluble in dilute hydrochloric acid. If heated in the oxidizing flame of the blow-pipe with borax or phosphorous salt, all tungsten compounds form colorless beads. In the reducing flame they produce with borax a yellow glass, in case the quantity of tungsten is large. Small amounts added to the bead leave it colorless. When heated with a phosphorous salt in the reducing-flame a glass of pure blue color is produced, as long as tungsten compounds are present exclusively. On adding a particle of iron salt to the bead it assumes a blood-red coloration, and on introducing tin the bead becomes blue or bluish-green.

Chemical Reactions. The trioxide is almost insoluble in a large excess of hydrochloric or nitric acids, which circumstance distinguishes it from molybdenum trioxide, MoO_3; but it dissolves readily in ammonia. Sulphuretted hydrogen, H_2S, produces no precipitate in acid solutions of tungstates, but reduces the WO_3 to the blue oxide W_2O_5. Ammonium sulphide, $(NH_4)_2S$, produces no precipitate from alkaline tungstates, but on acidulating with hydrochloric acid light-brown tungsten trisulphide, WS_3, is precipitated, slightly soluble in pure water, but insoluble in the presence of salts. The solution is colored blue. The precipitated sulphide dissolves readily in ammonium sulphide. Tin chloride, $SnCl_2$, gives at first a yellow precipitate; on acidulating with hydrochloric acid and applying heat the precipitate acquires a beautiful blue color. Zinc sub-sulphite reduces tungsten compounds to a deep brown tungstous oxide of unknown composition; in small quantities a deep blue color only may be produced.

Quantitative Determination. Reduce the ore to a very fine powder, weigh one gram and digest for 12 hours (over night) at a gentle heat with a mixture of four parts hydrochloric and one part nitric acid, till yellow pulverulent tungstic acid remains. Evaporate to dryness on water-bath, and take up with water acidulated by hydrochloric acid. Filter, wash the residue, consisting, besides the yellow trioxide, of silica and sometimes small quantities of niobic acid, with alcohol, and treat the mixture on the filter with ammonia. Place the filtrate in a large weighed porcelain crucible, evaporate to dryness on the water-bath, and heat the residue of ammonium tungstate to decomposition. Weigh the crucible with the remaining trioxide and calculate the percentage.

In a separate part of two grams of the ore, placed on a large watch-glass, determine the water-content by heating in an air-bath to 110° C. for a couple of hours. Moisture is shown by loss in weight.

A Fluorspar Mine in Colorado

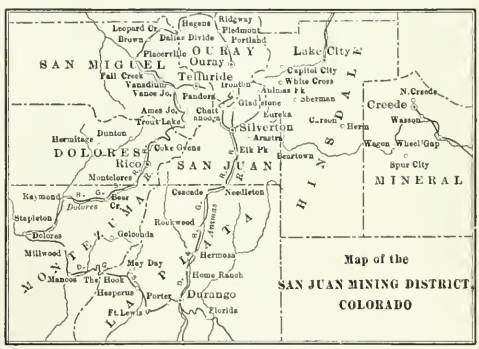
By HORACE F. LUNT*

Wagon-Wheel Gap, in Mineral county, Colorado, where the Rio Grande has cut a narrow pass through a ridge of hard rhyolite, was, apparently, one of the first localities to be named by the white settlers of the region, as it appears on the earliest maps. Perhaps it was named by General Frémont, 'the Pathfinder,' who is supposed to have wintered, during one of his exploring expeditions, in a fortified camp the ruins of which can be seen today on the cliffs that form the south side of the Gap. The hot springs on Goose creek, a mile south of the Gap, are equally well known and the Indians are said to have made use of their curative properties since time immemorial. Previous to the discovery of the rich mines of Creede in 1891, what is now known as the Creede branch of the Denver & Rio Grande railroad ended at Wagon-Wheel Gap, eight and a half miles south-east of Creede.

The fluorspar vein is just across Goose creek, to the east, from the hotel and bath-house at the hot springs. It was located many years ago for its supposed value as a precious-metal deposit, the locators believing that they had discovered an extension of the Amethyst vein, from which has come most of the ore that the Creede district has produced. As with many another prospector's hypotheses, there are no real facts to support this idea, but it is easy to see how it originated. Both veins strike in the north-west quadrant, the country-rock is the same, and the radiating crystals of purple fluorite in many specimens bear a surprising superficial resemblance to the amethystine quartz of the Creede mines. Many assays of the vein-matter and wall-rock gave returns of from $2 to $7 per ton in gold and silver.

In 1911 the prospect was visited by S. B. Collins, a mining engineer of Creede, who at once recognized the true character of the vein-filling. Subsequently he purchased the property and in 1912 and 1913 developed it, extracting about 5000 tons of fluorspar, which was sold to the Colorado Fuel & Iron Co. for use as flux in its open-hearth steel furnaces at Pueblo. Owing to the curtailment of steel-making operations, the demand for fluorspar ceased and the mine was shut-down in February, 1914. Recently a new contract has been made with the Colorado Fuel & Iron Co. and the mine is being cleaned out preparatory to resuming shipments. In a short time Mr. Collins expects to be producing 600 or 700 tons per month. The mine is so far from other markets that it is entirely dependent on the Colorado Fuel & Iron Co. as a consumer of its product.

The rocks in the vicinity are all intrusive, of Miocene age, and have been correlated with the Potosi series of the San Juan country[1]. The most prominent is a reddish fluidal rhyolite. Rhyolite tuffs and breccias, latite, and andesite have also been identified. The vein in which the fluorite occurs is a fissure, or fissured zone, in the rhyolite tuffs and breccias, and possibly in some places in the solid rhyolite flows. The wall-rock is so highly altered that in many places its real nature cannot be determined. It contains pyrite, sometimes in considerable quantity, generally altered to limonite or hematite. The vein-filling consists of fluorite, barite, altered country-rock, and gouge. Very little barite has been found more than 200 ft. from the surface, thus giving



the impression that it may disappear entirely as depth is gained. A few large cavities have been found filled with what appears to be pure kaolin containing minute crystals of fluorite. A little calcite is seen occasionally. The fluorite is white and massive with a sugary appearance, or in translucent, colorless to deep purple, crystalline crusts. The characteristic cubic crystals are not well developed and the exact crystal form is not usually apparent. Open cavities are common and are frequently lined with barite crystals on the fluorite. Nearly all the fluorite shows ribbon structure, or banding. Occasionally it has a greenish tinge instead of the prevailing purple.

The vein outcrops on the steep hillside forming the east bank of Goose creek and has been traced to the top of the hill, 700 ft. above the creek-bed, and for about half a mile farther east. No trace of it has been found west of the valley. The strike varies from north, 80° east to nearly due east and west. The dip is from 70° to 80° south. The most important workings are two adits. The lower one is about 75 ft. above the level of the creek. For the first 100 ft. it follows a sheeted zone,

*Mining engineer, Colorado Springs, Colorado.

[1]W. H. Emmons and E. S. Larsen, 'The Hot Springs and Mineral Deposits of Wagon-Wheel Gap, Colorado.' *Economic Geology*, Vol. 8, pp. 235-246.

two or three feet wide, which contains small stringers, seldom more than a couple of inches wide, of barite and fluorite. From the 100-ft. point the fluorite stringers become larger and in places the vein is six or eight feet wide with three or four feet of solid fluorite. The adit is 600 ft. long with a good showing at the face. The upper adit is about 500 ft. above and 1200 ft. farther east than the lower. The first 40 ft. is a cross-cut, beyond which it follows the vein for 200 ft. The character of the vein here is the same as in the eastern part of the lower adit. Above the upper adit are several surface tunnels and open-cuts from which most of the fluorspar produced was extracted. There is practically no spar left in any of them, excepting in the bottoms.

The flourspar and contiguous rocks are soft and are mined without difficulty by hand-drilling. The altered wall-rock is inclined to slough off in some places, but is easily held by light timbers. The large fluorspar streaks are generally divided from the wall-rock and the horses of country-rock in the vein by gouge, so that the shipping product is readily kept free from extraneous matter without elaborate sorting. The spar from the upper adit is dumped from the mine-cars into a small bin at the upper terminal of a jig-back aerial tramway, 1600 ft. long, which conveys it to a storage-bin of 400 tons capacity near the lower adit. The mine-cars from the latter are dumped directly into the bin. From this bin the spar is hauled to the railroad at Wagon-Wheel Gap by wagon or sled.

The run-of-mine fluorspar from this deposit is unusually pure. An analysis of the various shipments made to the Colorado Fuel & Iron Co. shows the following principal constituents: calcium fluoride, 90.08%; calcium carbonate, 1.17; oxides, chiefly sesquioxide of iron and alumina, 2.14; barium sulphate, between 3.22 and 6.00%[2]. It would undoubtedly be possible, by careful sorting, to ship a product that would run over 99% calcium fluoride if there were any object in so doing.

Two of the three hot springs previously mentioned are on a direct line with the vein. Presumably the spring-water comes from the vein. This water is described as "alkaline-saline, sodic-calcic-magnesic, sulphated-muriated-lithiated." No mention is made of fluorine in the analyses in the pamphlet issued by the company that owns the springs. An analysis of the travertine surrounding one of the springs shows 0.22% fluorine, corresponding to 0.45% fluorite. There seems to be no reason to doubt that the spring-water is of deep origin and from the same source as the waters that deposited the fluorite of the mine[3].

ARGENTINA has an area of 1,153,418 square miles, and a population of 9,000,000, of which Buenos Aires, the capital, has 1,700,000. Exports of coal from the United States to Argentina for the eight months ending March 1, 1915, were 184,393 tons as against 76,410 tons in the corresponding period of the year before.

[2]'Mineral Resources of the United States' for 1913, Part 2, p. 377.

[3]Emmons and Larsen, *Op. cit.*

Mining in Colorado

By GEORGE J. BANCROFT

The most important development in mining matters in Colorado within the past few weeks is without doubt the sharp advance in the price of silver. The stimulating effect of this advance is partly sentimental. The increase in the price of zinc means as much in dollars and cents based on present output as does the improvement in the price of silver. But high silver to the mining industry of this State is like plenty of oats to a spirited horse. It makes business prance with energy. Luckily or unluckily, according to the viewpoint, the present rise in the price of silver is not taken very seriously as yet by our experienced mining public. The fundamental causes of the advance are too little understood to inspire confidence of continuation. There is a feeling that the rise is an evanescent consequence of the War. There is, however, this hopeful feature: the silver-using nations are largely producers of foodstuffs and hence are waxing prosperous on war-orders, thereby becoming able to buy and coin more silver. To what extent this condition may prove an important and lasting factor in upholding the price of the metal remains to be seen. At present our mining men are hopeful, but cautious, and the customary enthusiasm attendant upon an improved market for silver is held in leash.

Flotation methods have been adopted with avidity throughout Colorado. There are now 24 flotation plants of one kind or another in the State. Most of them are small additions to existing mills and are little more than experimental plants. Such a large number of these installations have been successful that there is no doubt of the utility of the process to our mines. Colorado is primarily a state of many small concentrating plants. There are relatively few large installations and relatively little ore that is entirely free-milling, cyaniding, or straight-smelting in character. Most of it is concentrated on the ground. Even in the Cripple Creek cyanide mills it is customary to do more or less concentration. Furthermore the oxidized zone has long since been passed in most cases. To one who understands the process, its applications and limitations, it can readily be seen that it will be a very important factor in Colorado ore-dressing.

A rather unexpected application is reported from Cripple Creek, where it is said that the big Portland cyanide mill will be remodeled for a flotation plant. The Portland dump is now being sent through the old Stratton's-Independence mill and it is planned to send all oxidized or partly oxidized ores to this cyanide mill, keeping the flotation plant for the purely sulphide ore, which by the very nature of things, is difficult to treat by cyanide and easy to treat by flotation. Not many Cripple Creek mines can afford two mills, and for a general all-round process, it is doubtful if cyanide will soon be replaced at Cripple Creek. It is probable, however, that small flotation auxiliaries will be found useful.

Electro-Static Separation of Pyritic Zinc Ores

By J. H. LEWIS*

The history of the zinc-mining region of the upper Mississippi River valley is well known. Not until well into the sixties was much attention given to the mining of zinc ore. After the Civil War two young Bavarians, Matthiesen and Hegeler, came to Wisconsin in quest of zinc ore; their experience in Germany aided them largely, and resulted in the first zinc smelter in the United States being established at La Salle, Illinois. As soon as this market became available the miners turned their attention from the early lead deposits to the mining of zinc ore, both carbonate and sphalerite, of which the region offers large deposits. Crude methods prevailed, and practically the core of the orebodies was mined by hammer and steel. Not until 1904 was there a general awakening to the possibilities of modern mining equipment driven by steam, gasoline, or electric power. Just what rapid strides were achieved may be guessed, when it is said that the output in 1904 averaged about 2000 tons of crude concentrate per month, whereas at the present time the production has been increased to nearly 5000 tons per week.

In the early stages of local practice, using ordinary methods of wet concentration, the problem arose of securing a clean product for the market. It was found that the average concentrate contained only 30% zinc. The amount of high-grade ore sorted from the run-of-mine was small, and with the prices ordinarily prevailing prior to August 1914, it was found that unless this low-grade concentrate could be quickly and cheaply converted into a high-grade commercial product, very little profit would result. This led to serious investigation.

The pioneers in this work were A. N. Swart of Denver, now with the Guggenheims, and an associate named Pflumm. They experimented at the old Empress mine in the Benton district during 1896. Their plant was as intricate as it was crude. Although they failed at that time to accomplish anything, the knowledge gained finally led to the first really successful electro-static separation plant. Prior to this, Frank Trego, a brilliant young man, tried a machine in which the first step was to roast off the sulphur atom found intimately associated with most Wisconsin sphalerite. The ore was fed to a revolving base, built into a fire-brick cupola, the flames playing on the traveling ore from a chimney, the draft deflecting the flame downward. The roasted ore was then passed under highly magnetized poles, but the best that Trego could do was to secure a concentrate containing about 9% iron.

At the time that he was struggling with this complex problem, Charles C. Mathey, then as now, president of the Galena Iron Works Co., at Galena, Illinois, designed a revolving cylindrical hearth built of boiler-iron, and lined with fire-brick, in which annularly formed grooves extended around the drum. One end was open, and built into a furnace, while the other, slightly inclined, received the raw concentrate. The flames played on the ore as it followed its course through the hearth, the temperature being held at about 450°F., or just below the melting point. The red-hot ore fell into a tube in which propellers operated, and the ore was wormed out, being gradually distributed on a conveyor-belt passing under highly magnetized poles. The Mathey was the first of this type of machine to be a success, but in the process, the sulphur atom was entirely lost, and this was of value in the manufacture of commercial sulphuric acid. After years of absence, A. N. Swart again appeared on the scene. Instead of volatilizing the sulphur atom, the ore was first dried thoroughly in kilns. It was then conveyed to the top of an elevator-shaft, after being crushed to the proper size and then dropped onto screens, the elevator acting as an escape for the hot air from the dryers. From the screens the ore was distributed to the electro-static machines, where high-grade zinc product was made, and the pyrite conserved.

Two types of machines had been introduced, the Blake-Morscher of Denver, and the Huff No. 1 and 2 of Boston. The latter gave better results on the Wisconsin ore, and finally held the field against others. This plant, built mainly as an experimental station, cost $50,000, and was destroyed by fire after operating successfully and profitably for three years.

The period following the destruction of this plant was characterized by a steady demand for low-grade concentrate at a price that appealed to the miners of this region, because it gave a fair profit, but many extremely low-grade producers closed entirely, and scores of abandoned plants could be seen all over the district. Dry separation was again studied during the current year, when miners found no market for a low-grade product, that is, concentrate under 57% zinc. It was this situation that forced producers to resurrect some of the old separating plants, and in most cases to build new ones. By the end of 1915 there will be 12 plants of this type at work in the Wisconsin region, with a total capacity of 5000 tons of crude concentrate per week.

Up to the present time five distinct types of magnetic separators have been devised, and it is interesting to note the principal features of each:

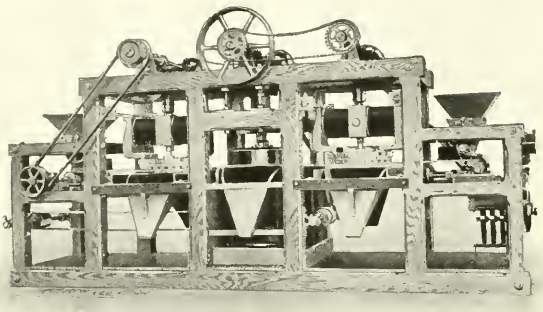
1. The revolving cylinder or drum, in two classes, (*a*) with magnetic fields created in grooves extending around the drum, and (*b*) with fields lying over or between pole-

*Platteville (Wisconsin) correspondent of the MINING AND SCIENTIFIC PRESS.

pieces extending around the face of the drum. These machines are for coarse material.

2. The double-pole crossed or tangent-belt machine, including a variety of belt-machines. This type consumes a great deal of energy; it requires close attention and frequent adjustment.

3. In which the magnetic particles are deflected out of the course of a falling stream of material. Machines of this type have the advantage of large capacity, and of producing a fairly clean magnetic material.



GENERAL VIEW OF SEPARATOR.

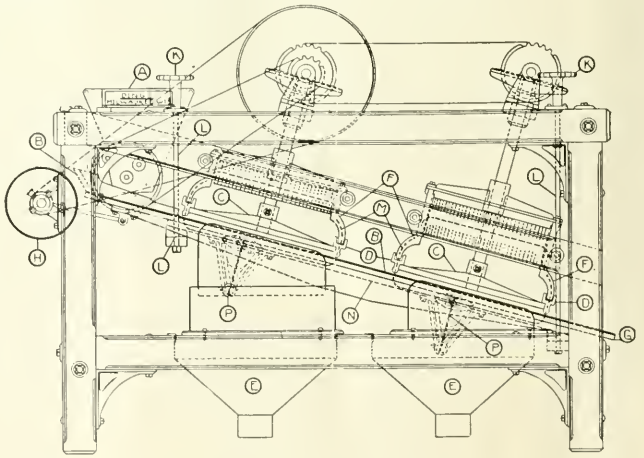
4. Vertical, single, or multiple magnets, revolving partly over a belt carrying the material to be separated. These machines produce fairly clean magnetic products when not crowded.

5. In which magnets oscillate from side to side directly across a flowing stream of material. Such is the Waring separator, installed at the Mills mine in the Hazel Green field, but was not efficient considering the quantity of material treated.

The ideal magnetic separator, to produce at a single operation perfectly clean, non-magnetic material, and equally clean magnetic products, assuring a large capacity with a minimum consumption of energy, requiring little attention or repair, and perfectly free from such defects as heating coils, burning out, etc., has yet to be invented.

All the requirements of the ideal machine are met, however, by combining the best forms of type No. 1, class (*a*) and type No. 4.

The New Jersey Zinc Co., at its separating-plant, operated in connection with the sulphuric-acid department at Mineral Point, now being rehabilitated after a shut-down of four years, on account of suits against the company for damage to shrubbery and lawns by fume, has five of the Mathey type of drum and Dings electro-static separating machines. Two types of this machine are now employed in combination at the Wisconsin Zinc Co. roasters at Platteville. At the National separating works in the Cuba district, the same methods prevail, but a different course is followed in preparing the ore. Instead of roasting the ore, it is crushed fine, thoroughly dried, and then distributed for separating into the different machines. Here, and at the Campbell separating plant, also owned by the Wisconsin Zinc Co., the pyrite is saved and sold, realizing about $3.75 to $4 per ton, an item not to be disregarded, as will be seen later. The Campbell type of plant is also working in the Linden district, but its capacity is limited. Another plant is being erected for the Wisconsin Zinc Co. at New Diggings, under the supervision of Homer S. Snow, general manager for this corporation. It will have a greater capacity than any plant in this region, being able to treat 150 tons of crude concentrate per 24 hours. This plant will house 10 of the Dings and Cleveland-Knowles machines, no expert labor being required. The National Zinc Works plant at Cuba is capable of handling 800 tons of crude concentrate per week. At this, as well as at the plants operated for the Wisconsin Zinc Co., the supply of ore comes from mines affiliated with the parent company, so that no outlet is offered through them to the small independent operators, many of whom cannot well afford the cost of building a complete separating-plant. This difficulty is being overcome gradually by custom roasters and separators operating at other points.



DINGS ELECTRO-STATIC SEPARATOR.

A—Hopper. B—Vibrating conveyor. CC—Wheels carrying secondary magnets. DD—Secondary magnets. EE—Discharge spouts. FF—Pole pieces of primary magnets. G—Discharge end of conveyor. H—Driving pulley. KK—Hand wheels, for adjusting inclination of conveyor. LL—Hanger rods. M—Magnetic circuit. N—Steel bridge. PP—Conveyor supports.

An example of magnetic separation is as follows. The average concentrate handled at the National Zinc Works, Cuba, shows the following composition:

	Raw product, %		Concentrate after separation, %
Water	2.80	Zinc	60.45
Zinc	34.40	Iron	2.38
Iron	17.00	Sulphur	30.00
Lime	1.90	Lime	1.84
Lead	0.30	Lead	0.30

The iron concentrate after separating contains about 4% zinc and 30% sulphur. The Wisconsin Zinc roasters at Platteville show a raw concentrate somewhat lower in both zinc and iron, with a finished product almost as high in value as that shown for the product obtained by aid of the process employed in the Cuba plants.

There is no uniformity in the concentrate produced locally. In fact, the metal-content ranges from a high-grade wet concentrate assaying 60% zinc to a concentrate as low as 20% zinc, and even leaner. In the very low grades, the expense of reduction is higher, but as the ore is worthless in its native state, it becomes obvious that it pays even to handle such low-grade ores. This statement is sustained by a report issued by Luther V. Rice, of the Fields Mining & Milling Co. (R. W. Hunt & Co., Chicago), general manager of the famous Crawhall and Thompson mines in the Shullsburg district. Here, 154 tons of 20% product was treated, from which 52 tons of 54% zinc concentrate was recovered. In the first instance the ore was unsaleable. Under the terms of a contract binding the Fields M. & M. Co. and the New Jersey Zinc Co., the finished product brought $111.11 per ton, although at the date of sale blende was freely quoted at $75 per ton. The cost of roasting and separating, including fuel and labor, according to Mr. Rice, was $300 for the 52 tons. In this case he had to consider the benefits accruing under a contract wherein sales are controlled by the ruling price of spelter. In all general transactions, open-market offerings governing the sale of ore, the profit is, of course, the great incentive to producing a high-grade concentrate. The relative loss in the concentrate treated is more than offset by the gain in profit on the finished product. It is unreasonable to think, or expect, that smelter representatives will enter into an agreement with ore-producers whereby they will be paid more relatively for a low-grade ore than for a high-grade separator product. Some instances exist, but when these contracts expire, as most of them soon will, sales will come in more generally on open-market offerings, and the advantage of the separating-plant will become increasingly apparent.

A retrospect of the field, now producing about 5000 tons of crude concentrate per week, impresses one with the great progress possible in metallurgy. The scope of operations is being enlarged daily, some of the most active producers having been developed from virgin soil within the past six months. That further progress will also be made in the reduction of low-grade zinc concentrate is certain, as engineers and metallurgists are diligently laboring to perfect a machine that will treat the raw product at one operation instead of the present combination processes, the consequent simplification and need of such an improvement being readily apparent.

Dredging at Panama

The Canal is closed indefinitely, and interest centres on the removal of the material forming the slides. Excavation from Gaillard cut during October amounted to 1,079,663 cu. yd., according to the *Canal Record*, compared with 1,052,586 yd. in September, 991,879 yd. in August, and 692,109 yd. in July. In October 872,952 yd. was taken from the bases of the Culebra slides.

Excavation in the seven days ending at 6 a.m., November 2, amounted to 257,029 yd., of which 236,549 yd. was from the Culebra slides. In addition, 8700 yd. was re-handled.

Excavation from the bases of the Culebra slides during the week ending at 6 a.m., October 26, amounted to 212,699 yd. Other excavation from the cut amounted to 61,246 yd., making a total for the week of 273,945 yd. The work by the several dredges during the two weeks was as follows:

Dredge and type.	Yardage. Oct. 26.	Nov. 2.
Gamboa, 15-yd. dipper	72,265	58,225
Paraiso, 15-yd. dipper	56,035	66,910
Cascadas, 15-yd. dipper	.....	5,640
Corozal, ladder	32,783	44,655
Cardenas, 5-yd. dipper	Repairs	Repairs
Chagres, 5-yd. dipper	25,610	9,320
Mindi, 5-yd. dipper	18,691	17,161
No. 86, pipe-line suction	34,080	29,180
Culebra, sea-going suction	27,166	26,912
Marmot, Belgian ladder	7,315	7,720

The 15-yard dipper dredge *Paraiso* broke a spud on October 25 and was towed to the north end of the cut for repairs, the spud being handled by the crane *Ajax*. The *Cardenas* was out of service during both the weeks for repairs, which were made at Paraiso. The ladder-dredge *Marmot* was taken out of the cut two days of the week ending October 26 to dredge away spoil which had obstructed a culvert under the Panama railroad north of Gamboa.

Salvador, the smallest of the Latin-American republics, is by no means the least populous. With an area of but 7325 square miles, which is less than that of New Jersey, it has a population of 1,700,000, which is equal to that of Kansas, while San Salvador, the capital, has 75,000. It is the only Central American republic that does not front on two oceans; its coast-line being on the Pacific. The total length of railways is but a hundred miles; however, a railroad is under construction that will connect with the railway system of Guatemala and will give Salvador a direct outlet to the Atlantic. Although in the tropics, Salvador has an equable climate by reason of the mountainous nature of the country. The annual production of gold and silver is between $1,000,000 and $1,500,000. The United States imports from and exports to Salvador to an extent greater than any other country. Salvador appears to lack currency, its supply aggregating only $11 per capita, including both circulating coin and credit money; nearly 30% of the governmental revenues appears to be required to meet foreign loans.

Vanadium

*Twenty years ago deposits of ores of vanadium were so little known and the use of the metal so ill-understood that its price per pound was in the thousands of dollars. Today at Pittsburg ferro-vanadium is quoted at $2.25 to $2.50 per pound of contained vanadium. The discovery of vanadium ore in Peru, and a better realization of the desirable qualities of the metal as an alloy in the making of high-grade steel, have united to increase its production to more nearly a commercial basis. The output in the United States of steel containing vanadium increased from less than 1000 tons in 1905 to nearly 100,000 tons in 1912, and, it is estimated, will reach 400,000 tons for 1915.

It is thought that the name vanadium was derived from Scandinavian mythology: the Swedish chemist, Sefstrom, named the element about 1830 during investigation of Swedish iron ores from which a remarkably soft and ductile iron had been produced. Vanadium compounds were first utilized for the manufacture of aniline black and indelible ink. Practically the first record of its use in steel was in 1896, when three armor-plates were made at the Firming steel works in France; these plates were notably superior to ordinary steel, but at that time no adequate supply of vanadium existed. In 1900, Prof. Arnold of Sheffield, England, made a series of tests that indicated that the addition of vanadium to steel raised the elastic limit 40 to 100% and increased the tensile strength 10 to 60% without affecting the ductility of the steel; chrome-steel containing vanadium likewise showed remarkable strength.

The real commercial value of vanadium was not realized until 1905 when M. Antenor Riza Patron, an engineer prospecting in the Peruvian Andes, discovered an important deposit of vanadium ore. The principal mines are operated now by the American Vanadium Co. of Pittsburg; Señor Patron is connected with the company in a consulting capacity, while Señor Fernandini, on whose property are the richest of the mines, is vice-president of the mining company.

Mining is by open-cuts and tunnels; native Indians acclimated to the rare atmosphere of 16,000-ft. altitude do the manual labor. The ore is roasted at the mines to reduce the sulphur and to concentrate the material to be shipped. The mines, at Mina Ragra, are 32 miles from the famous copper mining settlement of Cerro de Pasco. Llamas are employed to carry the concentrate in sacks of 125 lb. each over the steep and rocky mountain-paths six miles to lake Pun Ruyn where boats take it to the Peru Central railroad at a point 28 miles from the mines. These interesting animals, llamas, work under all conditions of weather, but positively will refuse to move if the bag of ore is an extra pound or two too heavy. At the plant of the American Vanadium Co. at Bridgeville, Pa., the concentrate is converted to ferro-vanadium, the commercial product, a hard, silvery-white alloy of approximately one part of vanadium to two parts of iron together with minor amounts of silicon, manganese, carbon, and aluminum. This alloy has a melting point of 1300 to 1340° C. which is below the fusing temperature of steel or iron, so that it can be absorbed readily in a molten bath of iron. The ferro-vanadium plant of the American Vanadium Co. has a maximum capacity of 30,000 lb. of alloy daily.

Vanadium-steel is employed extensively for special carbon and high-speed tool-steel, for parts of locomotives, automobiles, trucks, submarines, aeroplanes, guns, armor. As would be expected, the use of it has increased greatly since the War.

[Mention should be made of the vanadium produced in Colorado and Utah. In part it is found in carnotite ore and is recovered as a by-product from the production of radium, although it is contained in the ore in much greater quantity than the radium, and in fact the ores were prospected originally for the vanadium. High cost of transportation and irregularity of methods are being overcome slowly in these North American districts. Furnace-men assert that the function of the vanadium in steel-making is to "act as a scavenger" in removing impurities.—EDITOR.]

*Abstract of article by C. J. Stark in the *Iron Trade Review*, October 21, 1915.

The Recovery and Use of Thallium

BY L. S. AUSTIN

The General Electric Co. has found thallium* useful in incandescent lighting, and has need of about 100 pounds monthly, having in the past imported the metal from Germany.

On account of the European war this supply has been cut off and the company has been searching in this country in order to obtain an adequate supply.

Some varieties of pyrite and of zinc-blende contain thallium, and when these sulphides are roasted, thallium, being a volatile metal, deposits with other metals in the bag-house of the silver-lead smelter, and so is capable of recovery. But cadmium is also a volatile metal, and of late this has been recovered by a careful reducing roasting of the flue-dust, and the treatment of the calcine by leaching. From the filtrate is thrown down the cadmium, and, after further clearing of the solution from other cases, the thallium can be precipitated by means of zinc-dust. In the instance above cited, it was present in the solution to the extent of 0.012 to 0.017%. It is worth roughly $20 per pound; cadmium $1.50 per pound.

The use of the metal is so limited, except to supply an assured demand, that it would not pay except in a few instances to undertake its recovery.

*From the Greek *thallos*, green, since the metal burns with a beautiful green flame.

TUNGSTEN means in Swedish 'heavy-stone,' and was at first mistaken for tin ore, until the chemist, Scheele, showed in 1781 that the mineral scheelite contained lime and "a peculiar acid."

Effects of Soluble Components of Ore on Flotation

By AN OCCASIONAL CORRESPONDENT

In concentration by flotation, the soluble components of an ore may play an important rôle. Occasionally ores that are shown by preliminary test to be unsuitable for flotation may be treated by the process after the soluble ingredients have been removed by decantation. On the other hand, excellent results may be obtained on certain ores by flotation in fresh water; but when the water is fouled by successive contact with fresh lots of ore (as is often the case in mill-practice) the results may be far from satisfactory.

This article deals with a determination of the fouling agents in a certain ore, and outlines methods for overcoming such fouling effects. Since all tests were made on ore from a single mine, the results cannot be regarded as generally applicable; however, it is hoped that the experience recorded here may be of some interest to others studying similar problems in flotation.

The tests were made on a silicified-rhyolite ore assaying silver 37 oz., gold 0.15 oz., lead 1%, copper 0.25%, and zinc 1.5%. The principal minerals were argentiferous sphalerite, argentiferous galena, and stromeyerite. The value lay almost entirely in silver. For this reason, only silver assays are here recorded. Sufficient analyses were made to indicate that the concentration of zinc, lead, and copper roughly paralleled that of silver.

Preparatory to making the tests, a large general sample of the ore was ground to pass a 200-mesh screen, and thoroughly mixed. In each test, a 200-gram portion of the general sample was emulsified with one litre of water and 0.05% of crude pine-oil. The mixture was then treated for a half-hour in an experimental flotation machine, consisting of an agitation-chamber connected in such a manner with a concentrate-separation chamber, as to permit of repeated treatment of the tailing. Results in a flotation plant treating this ore roughly checked the work in the experimental machine.

Preliminary tests showed that when the ore was treated by flotation in fresh water, the tailing assayed 13 oz. silver and the concentrate assayed 440 oz. per ton. When the water used in the first test was removed by filtration and re-used on a second test, the tailing assayed 18 oz., and the concentrate 240 oz. When the same water was re-used a third time on a fresh sample of ore, the tailing assayed 27 oz.; the concentrate, 190 oz. Evidently some extremely deleterious substances had been dissolved from the ore. An analysis was made of the water filtered from the third test, with the following results:

Iron (ferric)	Tr.
Iron (ferrous)	0.002%
Aluminum	Tr.
Calcium	Nil
Magnesium oxide	0.012%
Sulphur	0.020%
Manganese	0.001%
Potassium and sodium	0.010%
Copper	Tr.

Most of the soluble minerals were present as sulphates.

The next step was to determine the effect, on flotation, of the various sulphates.

Sodium and potassium sulphates, when added to fresh tests in the proportion indicated in the analysis, yielded a 13 oz. tailing and a 650 oz. concentrate; thus producing a marked increase in the grade of concentrate without deterimental effect on the tailing.

Manganese, magnesium, and ferric sulphates produced no effect when added in the proportions indicated; in larger amounts, magnesium sulphate was harmful and ferric sulphate beneficial.

Ferrous sulphate proved extremely injurious to flotation. When present as above recorded, a 20 oz. tailing and a 240 oz. concentrate were produced. When a small amount of copper sulphate was added to the same quantity of ferrous sulphate, the tailing assayed 25 oz., and the concentrate 200 oz. Evidently ferrous and copper sulphates were the principal fouling agents in the original tests.

It was necessary to devise means for correcting the effects of these sulphates.

First: sufficient sulphuric acid and hydrogen peroxide were added to a charge containing ferrous sulphate to convert the ferrous sulphate to the ferric state. The tailing from this charge assayed 11 oz., and the concentrate 800 oz. With the same amount of acid, but using no peroxide, the tailing assayed 14 oz., and the concentrate 780 oz. Evidently the acid increased the grade of concentrate and also decreased the injurious effects of the ferrous sulphate upon extraction.

Second: efforts were made to precipitate the ferrous and copper sulphate. A test, containing these sulphates in the proportions indicated in the analysis, was rendered slightly alkaline by the addition of lime hydrate. The tailing assayed 12 oz., and the concentrate 450 oz. When sodium hydrate was used in place of lime, the tailing assayed 8 oz., and the concentrate 600 oz. With the iron precipitated by sodium carbonate, the tailing assayed 6 oz., and the concentrate 800 oz. With a combination of lime hydrate and sodium carbonate, the concentrate assayed 800 oz., and the tailing 3 oz. Evidently the use of hydrates and carbonates produces much better results than can be secured by acid. The cost of sodium hydrate and sodium carbonate, and the injurious effects of the latter upon settling and filtration, restricts the use of these chemicals. Lime hydrate, on the other hand, presents a cheap and efficient means for preventing the accumulation of ferrous sulphate in mill-solutions. The

calcium sulphate resulting from the reaction is somewhat detrimental to flotation; a saturated solution yielding a 16 oz. tailing and a 450 oz. concentrate. In ordinary practice the solution would be far from saturated, and the results much more satisfactory.

The lime-hydrate method has been successfully used on this ore in continuous mill-tests. During flotation the alkalinity was maintained as nearly as possible at 0.02 lb. lime-oxide per ton of water. After flotation, half the circuit-water was wasted, the remaining half being supplemented by fresh water at the head of the mill; lime sulphate thus being prevented from accumulating in the solution. For a month during which the process was used, the concentrate from the flotation plant averaged 600 oz., and the tailing 6 oz. This compares favorably with a 20-oz. tailing from gravity concentration and a 12-oz. tailing from flotation in an acid solution. Aside from effecting better concentration, the lime method is cheaper than the acid process and is not injurious to subsequent cyanidation.

When lime is used in flotation, extreme care must be exercised in maintaining the proper alkalinity. The table submitted herewith shows that the best results, both as regards extraction and grade of concentrate, are secured when the alkalinity during flotation is extremely low (between 0.01 and 0.02 lb. CaO per ton of solution). Experiments indicate that alkalinity is beneficial to flotation but that the coagulating effect of high lime upon slime increases the affinity of the slime for the froth, which lowers the grade of concentrate. When the coagulating effect is counteracted by the addition of sodium carbonate, or when sodium hydrate is used in place of lime, an alkalinity equivalent to a half-pound of CaO per ton of solution may be maintained without harmful effects on flotation. Usually a bare alkalinity maintained with quicklime produces equally good results.

In order further to study the effects of copper sulphate on flotation, a solution containing 0.01% $CuSO_4$ was employed in another series of tests. When this solution was used alone the separation was extremely poor, the tailing assaying 32 oz. and the concentrate 100 oz. When sufficient quicklime was added to produce a slight alkalinity, the tailing was reduced to 24 oz., while the concentrate increased to 180 oz. per ton. A further improvement was effected by the use of sodium hydrate, a 340 oz. concentrate and an 11 oz. tailing being secured. This was still far from satisfactory.

An attempt was made next to precipitate the copper as sulphide. By employing hydrogen sulphide in a solution rendered alkaline by lime hydrate, a 6 oz. tailing and a 450 oz. concentrate were obtained. When sodium sulphide and sodium hydrate were used, the tailing-assay was reduced to 3 oz., and the concentrate increased to 700 oz. These results show that the injurious effect of soluble copper may be overcome by the use of hydrogen or sodium sulphide in conjunction with lime or sodium hydrate.

The following conclusions were established for the ore tested:

1. Sodium, potassium, and ferric sulphates are rather beneficial to flotation than otherwise.

2. Manganese sulphate has practically no effect on flotation.

3. Magnesium and calcium sulphates are slightly harmful, while ferrous and cuprie sulphate are extremely harmful.

4. The effect of magnesium and calcium sulphates may be overcome by the use of sodium carbonate in an alkaline solution.

5. The effect of ferrous sulphate can be overcome by the use of sulphuric acid or, better still, by employing quicklime, caustic soda, or sodium carbonate.

6. The effect of copper sulphate may be overcome by the use of hydrogen sulphide or sodium sulphide in an alkaline solution.

7. The use of sodium carbonate, though aiding materially in flotation, is of doubtful utility in plants where the pulp must be dewatered.

8. Lime hydrate is slightly less satisfactory metallurgically than sodium hydrate or sodium carbonate, but the use of it is inexpensive and aids materially in settling and filtering.

Thawing Frozen Ground

A Russian method of thawing bottoms of shafts or pits in perpetually frozen ground is as follows:

Near the excavation is made a large fire-place. A fire is lit, and large stones—over 30 lb.—are put in it. When thoroughly heated they are thrown into the opening, cooling in 6 to 8 hours. They are taken to the surface for re-heating. In the meantime the upper part of the thawed ground is extracted. Then the stones are put in the pit again, the cycle of operations being continuous. A considerable amount of time, labor, and fuel are necessary, but the following advantages are claimed:

(1) The thawing does not prevent the accumulation of any quantity of water at the bottom, but on the contrary favors it, so that the water transfers its heat to the ground to a greater depth than is heated by an open fire; (2) the walls of the pit or shaft are never penetrated, and there is no caving, while in the case of the open fires this is a common and an expensive occurrence requiring extra expenditure in lining; and (3) there is no risk that the wood lining may be fired, which is possible in connection with open fires.

The degree of thawing effected in the ground by stones varies as in the case of fires, from 2 to 8 verchocks (3¼-14 in.) per shift of workmen, depending chiefly on the nature of the ground. The most rapid and easily melted are the poorly coherent marls of river beds, small pebbly conglomerations, and fine sands; and the worst is hard clayey ground, such as pure solid frozen clay and various combinations of clay. These deposits are easily displaced by means of explosives, but there are other kinds of ground such as marley clay with boulders which are difficult to extract either by fire or explosives.

[We refer to this subject on the editorial page.]

The Braden Mill, Chile

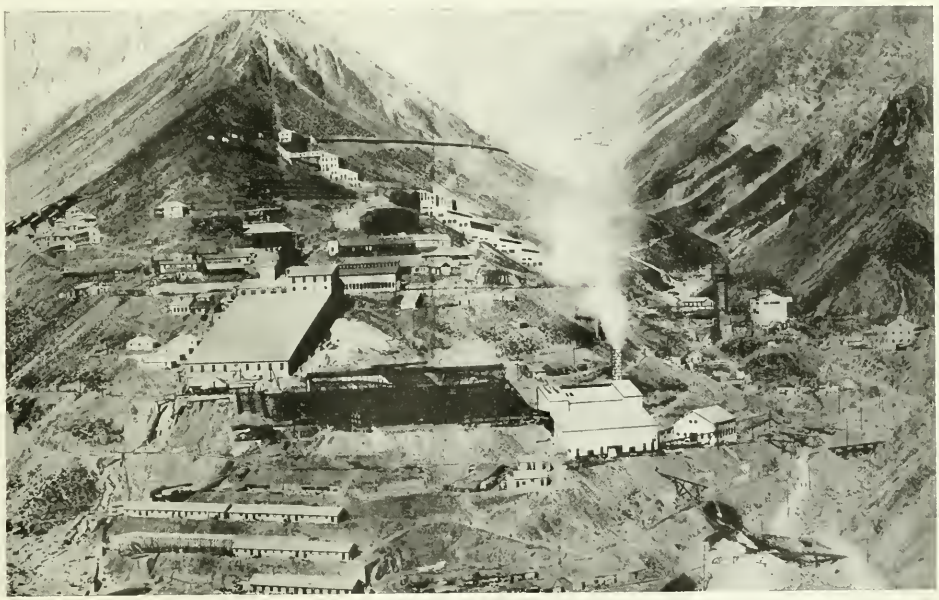
*The crushing and concentrator plants of the Braden Copper Co. are situated about two kilometres west of the mines on the northern side of the Teniente river. The topography is such that full advantage is taken of gravity in the transport of the ore from the mine and in the arrangement of the mill. The difference in elevation between the top of the coarse-ore bins, where the ore is received from the mine, and the bottom of the filter-press plant is 403 ft. The area covered by the entire concentrating-plant itself is 130,000 sqnare feet.

The ore is hauled from the mine to the coarse-ore bins on an electric railroad, and is weighed before it is dumped. These bins have a storage capacity of 2300 tons. Mechanical feeders deliver to a belt-conveyor system, which carries the ore to the crushing-plant. This is divided into two sections having the same number of machines of similar capacities, only one of which will be described. Each of these sections takes half of the stream from the last conveyor of the system. The ore passes over a 1½-in. grizzly, a series of flat-steel bars placed edgewise at an angle of about 45°. The oversize falls directly into a gyratory crusher, while the undersize joins the crusher-discharge which has been reduced to an average of less than two inches. These two products are then crushed to ⅝ in. in a pair of rolls 6-ft. diam. and 20 in. wide.

The discharge of these rolls is divided into two parts, each passing into a trommel. This has diagonal openings, 6 by 30 mm., through which fall the smaller pieces of ore. This portion is carried direct to the fine-ore bins by conveyor-belts. The part that cannot pass through the trommel goes to a 48-in. Symons disc-crusher, which reduces the ore to a maximum size of ⅝ in. The discs are of manganese-steel.

The discharge of the Symons machine passes over shaking (impact) screens with openings 6 by 30 mm. The smaller pieces are shaken through, and are taken to the fine-ore bins by the conveyors previously mentioned. The larger pieces go to two 36 by 15-in. rolls, and the remainder to two more 36 by 15-in. rolls, for re-grinding. The discharge from the latter joins the discharge of the first set of 36-in. rolls, and is elevated and passed over the same screens again. By means of this arrangement all the ore must pass through the 6 by 30-mm. openings of the screens, before it reaches the fine-ore bins preparatory to further treatment.

The fine-ore bins have a storage capacity of 3000 tons. From them the ore is delivered to the concentrator build-



THE MILLS AND SMELTER OF THE BRADEN COPPER COMPANY, IN CHILE.

*By the Mill Staff. Abstract from *Teniente Topics*. October 1915.

ing by means of belt-conveyors. The mill is divided into three units, each with a nominal capacity of 1200 tons per 24 hours, only one of which will be described, as the other two are similar.

From the final belt-conveyor the ore passes over four impact-screens with 25 openings per square inch, making a separation between the smaller particles, (which can now receive their first concentration) and the larger ones, which require further grinding in order to liberate the valuable mineral. These larger particles run from the screens down to two sets of rolls, then to an elevator, the discharge of which joins the fine that has passed the screens. At this point water is added, and the pulp flows to four trommels with screens having the same opening as the impacts. The material that passes through these screens is fed to six Wilfley tables. The concentrate flows to collecting-tanks at the foot of the mill; while the sand, which still contains a large amount of adhering mineral needing further grinding to free it, goes to eight Hardinge conical mills. These are half-filled with pebbles, having a maximum diameter of five inches. They revolve at 28 r.p.m. The oversize of the trommels mentioned is also treated in these mills.

All the discharge is now fed to two drag-classifiers. The sand is concentrated on six tables similar to those at the head of the mill, the concentrate going to the collecting-tanks, and the rejected sand to the next floor of Hardinge mills for still further grinding. On this floor there are six mills, which reduce the above reject or table-tailing to the size required for final concentration. These mills are each fed by a drag-classifier, the slime overflow of which runs direct to the flotation-plants. The whole discharge of the mills is elevated and returned to the classifiers, so that no large particles can escape from the circuit.

The ore has now been ground so that approximately all but 10% will go through a 60-mesh screen. The final concentration is effected by means of the Minerals Separation process. This is done in eight standard M.S. machines, which treat the ore from the three mill-units. Briefly, this process consists in adding a small quantity of suitable oil and sulphuric acid to the finely ground ore, thoroughly mixing them, and then allowing the resulting froth to come to the surface. This froth raises the particles of copper sulphide, leaving behind the particles of gangue material. The operation is carried out in wooden compartments, in each of which is a rapidly revolving agitator, connected with another compartment in front, in which the mixture comes to rest and the float is collected. The material travels from the agitating-compartment to the settler, from the settler to the second agitator, and so on until almost all the mineral content has been extracted. The float from the last two boxes of each plant is very low in copper, and is collected separately and re-treated, this pulp being pumped back to join the original feed of the plants. The sand, from which most of the mineral has now been extracted, is all collected into one launder, passed through a sampler, and then conducted down the valley to the tailing-dam.

The concentrate is collected in concrete tanks at the foot of the mill, from which it is loaded by means of a crane into railroad-cars to be taken to the smelter. The overflow of these tanks, consisting of sulphide slime too wet to be smelted, is run to Dorr thickeners. The thickened concentrate is drained by a Kelly press and an Oliver filter.

The following table gives some interesting data:

Ore treated per man per day, tons	8.5
Kilowatt-hours per ton milled	29.6
Acid per ton milled, pounds	7.00
Tar-oil per ton milled, pounds	2.00
Fuel-oil per ton milled, pounds	0.30
Local pebbles per ton milled, pounds	8.75

On account of the site of the plant, in a foreign country, and consequently the long distance from the main base of supplies, the duties and ocean freight on all sorts of material bring the item of supplies up to 60.4% of the total direct milling cost. The proportion of total cost chargeable to the various departments, for labor and supplies respectively, is shown in the following table; this also gives the proportion of the total direct milling cost that is borne by the different departments:

	Labor, %	Supplies, %
Coarse ore-bins and conveyors	4.07	2.51
Crushing-plant	21.29	16.02
Fine ore-bins, conveyors, mills, rolls and screens	9.02	7.17
Table concentration	7.04	2.97
Hardinge mills	21.98	25.00
Oil-flotation, main plant and re-treatment	22.81	42.58
Concentrate handling	8.33	1.14
Filter-presses	5.46	2.61

The San Francisco Mint

October receipts are reported as follows:

Gold.	Fine ounces.	Value.
English coin	422,323.272	$ 8,730,196.87
Japanese coin	30,129.165	622,825.12
Chinese bars	40,563.009	838,511.82
Australian bars	58,851.725	1,216,573.13
Other sources	256,732.404	5,307,129.75
Total	808,599.575	$16,715,236.69
Silver	96,727.67	47,779.15

Coinage amounted to $590,000 in eagles, and ₱10,000 in one-centavos for the Philippines. At the end of October the vaults contained the equivalent of $340,200,398.77.

Scheelite mining is becoming increasingly important around Atolia, near the line between San Bernardino and Kern counties, California, which is due west from Bakersfield. Both lode and placer mining is in progress. The lode deposits are thought to lie in a belt of granite 30 miles long. Lessees are active, and driving on bedrock under an overburden of 20 to 40 ft. is productive. The Atolia Mining Co., associated with Atkins, Kroll & Co., is now employing 250 men, and is producing 100 tons of scheelite per day, besides buying from lessees. A recent sale of 13 tons of concentrated scheelite brought $42 per unit of 60% WO_3.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

BLENDE is derived from the German *blenden*, to dazzle.

POWER INPUT to a transformer is always greater than the power output because of the losses within it.

WOLFRAMITE is a tungstate of iron and manganese. It is black or brown, resinous, metallic, with a hardness of 5 to 5½ and a specific gravity of 7 to 7½.

HUEBNERITE, or manganese tungstate, named from Huebner, a German chemist, has a hardness of 4½, and a specific gravity slightly over 7. It occurs usually in bladed forms possessing a perfect cleavage, but rarely is in distinct crystals. Its color is brownish-red to black, while its streak is yellowish-green to gray.

LITHARGE has been found a good substitute for lead acetate at Kalgoorlie, Western Australia. At the Perseverance mill the litharge is ground in a pan with quick-lime, in which it is soluble. From the pan the mixture flows to the tube-mill circuit, and then back with the unground sand in the main pan circuit.

WHERE THE LAND about a proposed shaft is flat and no dump is available, a sub-structure of heavy timbers may be built up above the site of the shaft for 8 or 10 ft. The rock hoisted from the shaft may be dumped around it, filling in the timber and rendering it rigid. In time a head-frame can be set upon this sub-structure.

COPPER and its alloys have been used for coins since the earliest records. In the United States silver and gold coins contain 10% copper; 'nickels' contain 75% copper and 25% nickel; pennies contain 95% copper and 5% tin and zinc. In 1914, nearly a million pounds of copper was used in the United States for coinage.

ONE MANUFACTURING FIRM in the United States uses 50,000 lb. of copper annually for bull-rings. About half a million pounds is used each year in making cans. Practically fifty billion pins are made annually in the United States; most of which are of brass containing 65% copper; apparently 5,000,000 pounds of copper is consumed each year for pins.

POTASH is reduced from wood ashes by pouring hot water on them. This produces a lye solution, which is evaporated in shallow pans to near dryness (6% moisture), when the crude salt is shoveled out. This material is calcined in a reverberatory-furnace, where up to 20% of the weight is lost. Some wood ashes contain a high percentage of potash and phosphoric acid.

POWDERED ALUMINUM is in heavy demand for use in explosive shells. When the shell explodes the powder flashes up brilliantly, as magnesium would do, indicating to the gunners where the shell exploded, and even illuminating the object at which aim was taken. Powdered antimony is used for the same purpose, but aluminum is pulverized with difficulty, while antimony can be crushed with ease.

VANADIUM is used in the manufacture of special steels, which contain at least 0.15% of the metal. Discussion has arisen as to whether the vanadium is a scavenger or not, some users holding that with carbon vanadium forms a double carbide of iron and vanadium, promoting the even distribution of the carbon and retarding constitutional segregation, while other users consider that vanadium is never added to steel for deoxidizing or scavenging purposes, but solely as an alloying metal, with the endeavor to lose as little as possible of the addition. The cost of vanadium is too high to allow such losses by oxidation.

MANGANESE-STEEL is used considerably in mining machinery, in such apparatus as crushers, ball and tube-mills and other comminuters, dredges, steam-shovels, stamp-mills, screens, pumps, and many others where the wear is very heavy. The metal is made by adding from 11 to 13.5% manganese to ordinary cast-steel. This increases the ductility of the product, making it tough and resistant to abrasion. The carbon content is 1.25%, and tensile-strength, 108,460 lb. per sq. in. The use of manganese-steel liners in tube-mills has given complete satisfaction. In one plant in Nevada a set of manganese-steel lifting-bars lasts 14 months, and a set of semi-steel liner-plates, 23 months; the consumption of metal was 0.049 lb. and 0.137 lb. per ton of material ground, and pebbles 4.83 lb. Lips for dredge-buckets are made of manganese-steel and riveted on. The tumblers are lined with this metal, and also the revolving-screens. Mine car-wheels give better results when of manganese-steel.

MOLYBDENITE is produced largely in Queensland, Australia, and a recent discovery is reported from the Mt. Perry district, 58.5 miles from the port of Bundaberg. During the quarrying of a quartz outcrop for ballasting a railway, and for use in smelters nearby, years ago, the molybdenite was detected, but remained unworked until last December. At a depth of 55 ft. results have been excellent. The molybdenite occurs in the quartz (rarely in the surrounding pegmatite) in radiating crystal masses. The largest single piece found weighs 3 lb. The quartz in the 'pipe' is remarkably free from other minerals, not even pyrite. A sample of hand-cleaned molybdenite gave 57.7% molybdenum, and 38.7% sulphur. Associated with the molybdenite at the 55-ft. level is a good deal of dark greenish-blue mud, apparently a decomposed chlorite, and this also occurs filling most of the joints in the quartz. According to a late visit of the government geologist, Lionel C. Ball, the Tyrconnel is a mine of great promise.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

PLATTEVILLE, WISCONSIN

Big Profits.—Zinc Sulphide.—New Plants and Labor.—Lead, Pyrites, and Zinc Carbonate.—District Outputs.

Higher prices for spelter and zinc ore in November resulted in a large influx of wealth to this region. Shareholders in companies have clamored for prompt distribution of profits. One concern paid two 10% dividends in a month; another 140% for the year; and another 85% for 1915.

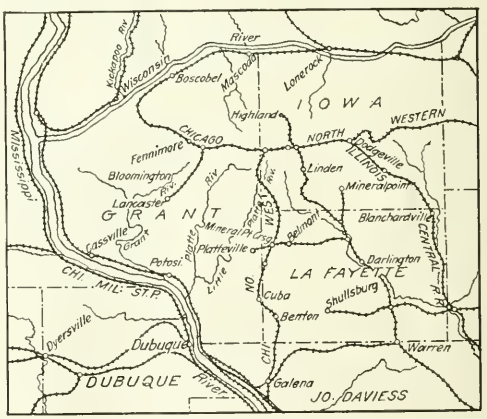
The turn-in of crude ore was high, and a greater amount of finished material from the local refineries cleared direct for smelters than in any previous month. Top grades cleared $115 toward the close of the month, and the range held well at $105 to $110 per ton with no restrictions on all grades from the highest to the lowest. This resulted in an almost abnormal influence on miners, many of whom broke away from pay-rolls with which they had been long associated, to try mining on their own account. Many long abandoned low-grade mines were reopened, and the poorest ores commanded prices that meant large profits to the small operators; 50% material selling as high as $75, 45% at $50, and 40% at $45 per ton. Even a quantity of lower grade was disposed of readily to the separating-plants. The capacity of these was greatly enlarged by the starting of three new plants at scattered points, enabling custom-plants to buy more freely from independent operators, many of whom had been hoping for an outlet for low-grade material. Double shift became the rule at all mines where sufficient labor could be secured. Separating-plants were operated at maximum efficiency full time. Storage-bins were cleaned out completely.

A year ago this region was lightly regarded by leading operators, but now it is a Mecca for mining men, and capital is flowing into the field from all parts of the United States. Hotels are full of strangers. The two leading railway companies are considering routes for two branches into the centre of the field. At New Diggings district, the Wisconsin Zinc Co. fired up a new ore refinery on November 20, coating $100,000 or more. Another new separating-plant was started at Galena for the Great Western Mining Co., constituted mainly of railway officials connected with the Great Western Railway Co. Another refinery is being constructed at Galena, on the Illinois Central railway by the Galena Refining Co., incorporated under the laws of Illinois organized by leading officials of R. W. Hunt & Co., of Chicago. Seven acres of land was purchased in the city limits, and the new plant, which it is proposed shall be put into commission in January, is built to show a new method of electrolytic zinc-ore separation that it is said will supersede all present methods. The New Jersey Zinc Co. completed a re-modeled acid works at Mineral Point, and commenced shipping a 25-ton tank-car of commercial sulphuric acid per day. In the New Diggings district, where less than two months ago under 500 men were employed in mining, 1000 men were at work on December 1. Labor conditions are good. At one or two points threatened strikes were quickly averted by cool heads, to the material gain of the men. In the Benton district several operators pooled issues, and are now engaged in the building of macadam roads to enable outlying producers to ship all the year round.

Sales of lead ore increased, but were light. Ore climbed steadily from $62 and $64 to $70 and $75 per ton, receding again to $65 and $70, at which figure the month closed, with sellers reluctant to let go. Some ore, however, was carried over.

Producers met with a more insistent demand for pyrites, and slight gains were recorded in price, but little crude ore was offered, and such as did clear came from the separating-plants in the field, which are arranged so that this mineral can be conserved. Much of this ore is now finding its way into the bins of powder-manufacturing establishments.

Miners of carbonate zinc ore were surprised to get as high as $80 per ton for 40% product. The demand for ore stimulated the cleaning-up of old dumps. About 1500 tons or more of dressed ore, ready for prompt shipments, awaited a demand from buyers at the close of the month, but peculiar conditions confront the miners of this class of ore. The price is too high to pay where the ore is used in the manufacture of zinc oxide, and not high enough in zinc content to be used for spelter in this form.



THE ZINC REGION OF WISCONSIN.

Deliveries reported by districts were as follows:

Districts.	Zinc, pounds.	Lead, pounds.	Pyrites, pounds.
Benton	13,166,000	165,000	.....
Mifflin	5,664,000	80,000	.....
Cuba	3,656,000	.....	1,597,480
Galena	3,564,000	65,100	81,000
Platteville	3,494,000	.....	1,490,000
Hazel Green	2,824,000	64,200	.....
Linden	2,590,000	80,000	389,800
Shullsburg	1,094,000	.....	.....
Highlands	988,000	.....	.....
Dodgeville	222,000	.....	.....
Potosi	134,000	.....	.....
Mineral Point	64,000	.....	.....
Mineral Point Zinc Co.	3,723,700	.....	.....
Total	41,183,700	454,300	3,558,280

The gross turn-in of crude ore from all mines exceeded 31,000,000 lb., and net deliveries direct to smelter 20,327,700 lb. Less than seven years ago the total shipments for a single given month would scarcely exceed 2000 tons.

Sales were distributed among the following smelter concerns: Mineral Point Zinc Co., 4778; National Separating Works, 5162; Wisconsin Zinc Roasters, 2353; American Metals Co., 1196; M. & H. Zinc Co., LaSalle, 1067; Grasselli Chemical Co., 1007; Granby Mining & Smelting Co., 818; Illinois Zinc Co., 643; Lanyon Zinc Co., 721; and American Zinc Co., 352; also the Picher Lead Co., and several roasting establishments.

TORONTO, ONTARIO

Developments at Deloro, the Plenaurum, Tisdale, Porcupine, Tashota, and Ogden.—Molybdenite.—Steel.—Reports.

Interests allied with the New Jersey Zinc Co. have taken an option on the Dobie and Maidens-MacDonald groups of claims in Deloro township, and early next week will inspect the Davidson claims in northern Tisdale.

The Plenaurum shafts have been de-watered, and Mr. Beidelmann, representing D. Lorne McGibbon and the La Rose interests, has commenced sampling the property. The Porcupine Excelsior Mining Co., which has recently purchased the Pope claims in southern Shaw township, has its two-stamp mill at Sherrill's landing on the Redstone river, and as soon as the river freezes sufficiently will erect it on the property. Some remarkably rich specimens of free gold are on exhibition from this property at the Goldfields hotel at Timmins. This company has now completed its winter road to Porcupine, and is ready to take in supplies when the sleighing is good.

The Porcupine Contact Mining Co. is resuming operations at its claims at Tisdale, half a mile north of the Dome.

Porcupine as a whole is continually increasing in activity, and several representatives of financial groups in the United States are there looking for mining properties. This, with the excellent results obtained by the various producing properties, has resulted in a fairly active share market.

Another discovery of free gold with tellurides has been made at the Devaney claims in the Tashota Lake district on the trans-continental railway.

The Hayden Gold Mines, Ltd., in Ogden township, is crosscutting south from its shaft to intersect any veins between the shaft and the contact between the quartz-porphyry and the schist; also to the north to the contact with the diabase-dike.

An interesting discovery of molybdenite has been made on mining claim P 7171 in Deloro township, in a jaspillite zone. The jaspillite has undergone considerable shearing and fracturing, and the fracture-planes have been impregnated with secondary quartz associated with sulphides of iron and copper. The molybdenite occupies a zone about five feet wide, and is associated with the secondary quartz in crystal aggregates ranging from $\frac{1}{8}$ to $1\frac{1}{2}$ inches diameter.

The requirements of the shell industry have resulted in great activity by steel manufacturers. All steel plants are working to full capacity, and several are making additions.——The Dominion Steel Corporation has started a new merchant-steel mill.——The Steel Co. of Canada will enlarge its plant at Hamilton, Ontario, by the construction of three new open-hearth furnaces and two forge-shops, and will extend its blooming-mills.——The plant of the Northern Iron & Steel Co. at Collingwood, Ontario, which has been idle for some time, will be re-opened under new management.——There are now 320 plants in Canada engaged in the manufacture of shells or their component parts. According to a statement by Alex. Bertram, formerly chairman of the Canadian Shell Committee (which body has just been superseded by the Imperial Munitions Board), the shell orders from Britain now in hand call for 20,000,000 shells, worth approximately $220,000,000. In addition, further orders to the amount of $180,000,000 are anticipated before the end of the year. The amount of material required to fill these contracts, present and prospective, includes 80,000,000 lb. steel, 45,000,000 lb. copper and brass, and 1,500,000 lb. tin. To aid in securing adequate supplies to keep the plants busy the Government has appointed a commission to inquire into the supply and sufficiency of raw materials in Canada required for the production of munitions of war, and the best methods of conserving them. The Commission includes Thomas Cantley, president of the Nova Scotia Steel & Coal Co., chairman; George W. Watts, Toronto, E. Carnegie, Welland, Ontario, Robert Hobson, general manager of the Steel Company of Canada, Hamilton, Ontario, the Hon. W. E. Edwards of Ottawa, and George C. Mackenzie of the Canadian Department of Mines, Ottawa.

The sixth annual report of the Hudson Bay Mines Co., for the year ended August 31, 1915, has been published. Work at Cobalt was confined to No. 2 workings. Shaft-sinking, exploration, and diamond-drilling was done, the last being satisfactory in the conglomerate. Assessment work was done at Kirkland Lake. The Dome Lake property was an active producer.

The Seneca-Superior Silver Mines, Ltd., of Cobalt states that its dividends in 1915 total $335,219, including 10c. per share (478,884 issued out of 500,000 authorized), on December 15. The total in three years is $981,212, equal to 205%. On November 20 the cash on hand amounted to $240,000. Seven cars of ore are in transit. The cost in October was $3.55 per ton, or 4.8c. per oz. of silver, against $4.25 and 9.6c. in June.

WASHINGTON, D. C.

Leasing Proposals.—Mining Laws.—Bureau of Mines.

The leasing bills have made an early appearance in Congress, and one of the earliest is that of Representative Mondell of Wyoming, who is a man of long experience in Washington and of some importance. He is a Republican, and therefore of greater influence when this party is in power. His advocacy of leasing shows an important trend, which is emphasized in this case by the fact that he belongs to the anti-conservation group. His bill provides for the leasing of coal lands, and permits the Secretary of the Interior to grant licenses giving to holders the exclusive right to prospect and explore for coal on vacant public lands, and to execute leases authorizing the lessee to mine and remove coal from such lands. No license shall pertain to more than 3200 acres, and no lease shall pertain to more than 2560 acres and all the areas shall be reasonably compact in form, and conform to the public surveys. No prospecting period is to be issued for longer than three years. Rental and royalty on coal mined is part of the leasing scheme. A monopoly in whole or in part in the trade in coal is forbidden. Inspection of the mines by the Department of the Interior is arranged for. The United States also reserves for itself a preference right to take as much of the product of any mine as may be necessary for the army, the navy, and the revenue-cutter service, of course for a remunerative price. Seventy-five per cent of all the money derived from licenses and leases granted under the act is to be paid to the State within which are situated the lands so leased, the money to be utilized for the construction and maintenance of roads, the establishment and maintenance of schools, and other purposes that the legislature of the State may provide.

A meeting of delegated mining men is to be held in Washington on December 16 to urge Congress to appreciate the necessity of revising the mining laws. Three sessions are to be held on that day. The details are almost as elaborate as a convention. The proposed legislation is to be thoroughly discussed, but without needless detail to bewilder Congress.

The first annual report of Van H. Manning, director of the U. S. Bureau of Mines, has been presented. It discusses the large industrial achievements by American manufacturers, the large sums of money saved by utilizing previously wasted material, and the new industries created to manufacture what formerly has been imported, and the consequent growing industrial independence of the United States. Mr. Manning says that the Bureau is trying to find new and profitable methods for treating the millions of tons of unworked low-grade ores in the West.

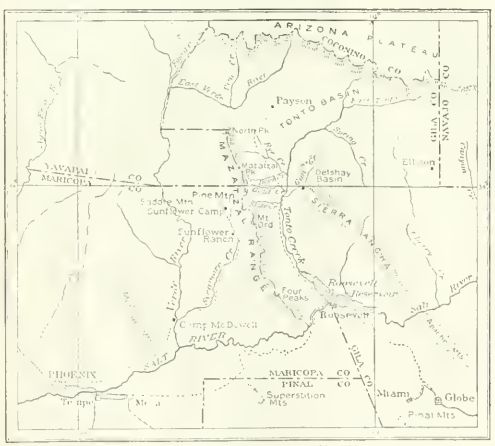
THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ARIZONA

Prospecting for and development of tungsten properties in this State is on the increase. During the past few weeks the State Bureau of Mines at Tucson has had inquiry from responsible syndicates in the East desiring to purchase tungsten mines, and the Bureau announces that it will be pleased to communicate the details of any tungsten properties that may be called to its attention.

The quicksilver deposits of the Mazatzal range, in the Tonto national forest, are described by F. L. Ransome in Bulletin 620-F. of the U. S. Geological Survey. The area is a well-defined ridge in central Arizona, about 40 miles long. At each end are peaks 7600 ft. high. The quicksilver deposits occur in a strip of country six miles long, north-eastward across the range near Pine mountain. All of the claims are



PART OF CENTRAL ARIZONA.

in the Sunflower district, which lies at an elevation of 4350 ft., 70 miles from Phoenix by road and trail. Freighting costs $40 to $50 per ton. The publication describes the routes of getting there. Cinnabar was found in October 1911 by E. H. Bowman. His and other claims were purchased by the Sunflower Cinnabar Mining Co., organized in February 1913, with a capital of $1,000,000. A retort-furnace was erected in September of that year. The geological features are detailed. The deposits are lodes in schist. Some chalcopyrite, specularite, and native mercury are found. The lodes do not outcrop conspicuously, and are more commonly marked by a slight depression than by a ridge. Claims in the Maricopa County belt have a length of 24,400 ft., and in the Gila County belt, 25,500 ft. A good number of adits have been driven. The lodes are persistent, and prospects are very promising. Considerable quantities of 2% ore can be obtained with moderate sorting, but better reduction methods must be arranged.

According to P. E. Joseph in Bulletin No. 5, Mineral Technology Series No. 3, of the Arizona State Bureau of Mines, molybdenum is found in limited quantity in many widely separated localities, namely Helvetia, Madera canyon, Providencia canyon, Duquesne, and all along the international boundary. Helvetia is situated 27 miles south-east of Tucson, in the northern part of the Santa Rita mountains on the west slope, at an elevation of about 4300 ft. Here, molybdenite is found in the Leader and the Ridley mines. The former is situated east of the town at an elevation of about 7400 ft., near the contact of the altered Paleozoic limestone with underlying pre-Cambrian and post-Carboniferous granite. The molybdenite occurs in lenses, irregular bodies, or in masses and crystal aggregate embedded in a dull-brownish and greenish to yellowish, mineralized, garnetiferous, silicified-limestone and quartz, which rock has resulted from contact metamorphism of the intrusive granite with the limestone. The molybdenite is mostly fine grained, but in places it is found in crystals ranging up to one-half inch and more in diameter. In the Ridley mine, situated to the south-west of the town, at an elevation of about 4060 ft., some fine-grained molybdenite is found in the lower portion of the vein, in a band composed of sericite mica, quartz, pyrite, and varying in width from one-eighth to four inches. Madera canyon drains the north-eastern part of the Old Baldy section of the Santa Rita mountains, about 10 miles south-west of Helvetia, and 35 miles south of Tucson. In the foothills part of its course, where the creek crosses the Pima-Santa Cruz county line, are found the McCleary prospects. The country rock is pre-Cambrian (?) granite. It has been fractured by dynamic disturbances, and along the resulting joints and fault fissures occur quartz veins. In these quartz veins molybdenum is found in heavy, thick masses, quite clean and pure. In Duquesne, and along the international border, molybdenum does not occur in sufficient quantities to be of commercial importance. In the Mammoth gold mine, at Shultz, Pinal county, wulfenite occurs abundantly, sometimes in aggregations of crystals, weighing many pounds. For many years the Mammoth, which was a famous gold mine, has been accumulating tailing on the dump, which has been picked over, and for three years has afforded the entire output of wulfenite marketed in this country. The Troy Manhattan Copper Co. has discovered sufficient wulfenite to warrant the erection of a 40-ton mill for concentration of the molybdenum ore, and a plant for treating the concentrate. Wulfenite, in association with some vanadinite, is found in the Old Yuma mine, about 20 miles northwest of Tucson. Molybdenite is also found in disseminated ores of Miami, in copper ores of Clifton-Morenci district, with copper in Hualpai mountain, Maynard district, in Pinal county in ores at Ray-Kelvin mines as original mineral. Recent newspaper reports state the discovery of many molybdenum deposits in various parts of the State. However, these have not yet been sufficient developed. Most of the deposits in Arizona occur under geological conditions favorable for the molybdenum, and it is very possible that further development may make many deposits of commercial value. An important point in the selection of deposits for development is the absence of chalcopyrite, which reduces the market value of the ore, due to the difficulty of separating the chalcopyrite from the molybdenite.

Gila County

Instruction in first-aid has been resumed at the Old Dominion, with Orr Woodburn, formerly with the U. S. Bureau of Mines, in charge. Last year over 400 men were trained.

Greenlee County

It has been alleged that the Arizona, Detroit, and Shannon copper company's relief camp at Duncan was a refuge for strike-breakers, and that the Hon. Chas. G. Harris, adjutant-general of Arizona, had made certain remarks about the company's operations. This led to correspondence between the managers, Norman Carmichael, M. H. McLean, and J. W. Bennie and Mr. Harris, the latter giving his views of the situation, and the managers replying in strong terms to him for his connection with the strike, also denying that strike-breakers were in camp.

Mohave County

Mining developments at Oatman are briefly discussed by J. Nelson Nevius in the November *Mining and Oil Bulletin* of the Chamber of Mines and Oil at Los Angeles. The notes are well illustrated. The mines mentioned are the Tom Reed, Gold Road, United Eastern, United Western, Big Jim, Black Eagle, Telluride, and Sunnyside. The topography east of Oatman is rough, due to faulting. Volcanic 'necks' are a feature of the area.

While cutting out a station at 400 ft. in the Big Jim mine on November 27, ore similar to that in the Tom Reed and United Eastern was cut.

At a depth of 1175 ft. in the Tom Reed the vein is 6 ft. wide, assaying as high as on other levels.

Ont at Yucca the Yucca Tungsten Mines Co. has 40 men constructing a road to its property. A mill of large capacity is to be erected. A good deal of tungsten ore occurs in the district.

Another good ore-shoot has been cut at 530 ft. in the Boundary Cone.

Pinal County

The Ray-Hercules mine has commenced shipping carbonate ore assaying 7.27 to 7.58% copper; the dumps contain 1000 tons. Drills are now searching for barren ground in which to sink the main shaft. Drill-hole 28 has found 145 ft. of 2% ore from 475 to 620 ft. depth. The company has $975,000 in its treasury at Boston.

CALIFORNIA

Amador County

The South Eureka company distributed $20,998 in November, making $230,988 for 11 months.

At the Allen copper mine near Ione the water is being coped with easily at 500 ft. Three shifts are working.

Butte County

The California Gold Mines Co. has been organized at Salt Lake City to operate the Forbestown Consolidated, with a capital of 1,000,000 shares at 5c. each. At the Gold Bank mine 20 stamps are at work.

Mariposa County

The Mariposa Commercial & Mining Co. is being sued by G. W. Langan for $1,500,000, involving title to the Mt. Bullion property, the Mariposa mine, and the site of the town of Mt. Ophir. It is alleged that the company failed to sell the properties after agreements to this effect had been arranged and the first payment made. The price for 44,386 acres was $1,000,000.

Plumas County

(Special Correspondence.)—On Jamison creek, about one mile south of the town of Johnsville, and about ¾ mile south of the Plumas-Eureka mine, are situated the Jamison Mining Co.'s properties. The main vein was discovered in 1889 by placer miners working the gravel deposits in the bed of Jamison creek. The ownership, however, has long since passed from the original locators into the hands of Eastern people, chief among whom are the Burnhams, of the Baldwin Locomotive Works, the Corbins of the P. & F. Corbin Lock Co., who have extensive factories at New Briton, Conn., the Distons of the Diston Hardware Co., and the Cheyney family of Philadelphia. The vein averages about 9 ft. in width, and is composed of white quartz, which is very brittle and easily milled, and contains at depth a considerable proportion of sulphides. It has been worked for several thousand feet along its strike, although the greatest depth at which ore has been extracted is not over 500 ft. The average gold-content does not exceed $3.50 per ton. However, because of the uniform width of the vein, and the fact that the gold is remarkably evenly distributed through it, the expense incidental to handling waste and sorting is eliminated, so that the extraction of the ore can be done on an

THE JAMISON MINE AND MILL, PLUMAS COUNTY.

economical basis. The strike of the vein is north-west and south-east and the dip about 26° toward the west. In 1896 a 20-stamp mill was erected a short distance from the collar of the main shaft, and has been operated practically every season since that time. The ore is trammed by car from the mine to the mill, where it is dumped onto grizzlies. The fine material is delivered directly into a bin, from which the stamps are fed, and the larger pieces pass onto a platform from which they are shoveled into a crusher. After passing a 50-mesh screen the pulp from the stamp flows over copper plates for amalgamation. These plates are of unusual size, 5 ft. wide by 20 ft. in length. The mill treats about 68 tons per day. At the present time no attempt is made to save the tailing; frequent assays show that it is worth less than 50c. per ton. Power for operating the mill, hoisting, air-compressors, dynamos, etc., is furnished by Pelton water-wheels. Water comes from three lakes, (Grass, Jamison, and Wades), the nearest of which (Grass) is situated about 1½ mile south of the property, and at an elevation of 400 ft. above the mill.

Johnsville, November 22.

Shasta County

(Special Correspondence.)—Construction of the Gardella dredge on Clear creek is progressing steadily, and the management expects to start operations early in March. Delayed shipments of lumber have interfered with rapid construction. ——The old dredge of the U. S. Dredging Co. has been moved to the Perry Marks farm, near Redding, and is about to start work on promising ground.——The Shasta Dredging Co. has completed an excellent camp at Gas Point, and is dredging a large gravel deposit, parts of which are rich. Approximately 700 acres is available.

The Victor Power & Development Co. has paid the final installment of $35,000 on the price of the Midas group, at Harrison Gulch. The total price is said to have approximated $125,000. Vigorous operations are proceeding in the Midas mine, and work is to be more aggressively pushed in the Gold Hill and Bonanza properties. C. D. Jackson is manager, and J. A. Sharp, of Red Bluff, president.

Redding, December 6.

Siskiyou County

(Special Correspondence.)—The Big Cliff Mining Co. has completed its new sawmill and will have it running in a few days. The first lumber will be used in construction of the 7700-ft. tramway from mine to mill-site. Building of a mill and numerous surface structures will be rushed as soon as weather permits, and the management expects to be in a position to produce largely early next July. Considerable ore has been blocked out. M. T. Olsen is manager. The property is situated on south Russian creek.

Important quartz and placer developments are reported from the Sugar Hill mine, at Fox creek. A series of shoots ranging from two to six feet wide has been uncovered in a porphyry dike, the quartz being of good milling grade. The old gravel-channel has been intersected and an adit has been started to open the back channel.

Shipments of high-grade ore are being made to the Johnson mill from the Oom Paul mine, at Oro Fino. A vein of milling ore has been cross-cut 12 ft., and a good quantity is exposed. The vein was uncovered in the foot-wall of the narrow vein the former owners worked. W. R. Renfrew is managing owner.

Dan Malloy, owner of the Malloy quartz mine at Tanners peak, near Sawyers Bar, has erected a small stamp-mill, and expects to start crushing soon. Considerable medium-grade ore is available.

Etna Mills, December 13.

The McKean mine has closed for the winter. Developments were satisfactory. A mill and cyanide-plant are contemplated by the owner, Mr. Kenney. The mine is in the Callahan district.——Adjoining the McKean is the Hurzey, where some good ore has been opened.

Trinity County

Owing to a dispute among the shareholders of the Trinity Consolidated, its placer properties have been leased; that at Douglas City to C. H. Tarpley, and that near Weaverville to Otto B. Haas.

Four giants are sluicing at Lagrange and there is plenty of water.

The examination of the Globe Consolidated at Dedrick has been completed by Samuel W. Cohen of the Crown Reserve company, Cobalt, Ontario. There is considerable snow around the mine and mill at present.

Tuolumne County

(Special Correspondence.)—Chas. Helman of the El Oro Dredging Co., Oroville, has taken over the Dondaro Yankee Hill gravel area. The company expects to erect a dredge of large capacity.

The Corrall Gold Hydraulic Co., under the management of Chas. S. Young of Hermosa Beach, is taking over the gravel claims east of Columbia, and will probably equip it for hydraulic mining. The property consists of 100 acres and includes the Rehm, Bacigalupi, and Hastings land. H. M. Gorman of Los Angeles is interested with Mr. Young in the scheme.

A new compressor is to be installed at the Hope mine, east of Sonora. The superintendent, Mr. Weston, is also making other great improvements. Some good ore has been extracted lately, and prospects seem good.

Work at the Rawhide mine near Jamestown is progressing well. The electric hoist and head-frame are in place, and the shaft cleared and timbered to water-level, which is about 60 ft. from the surface. On account of the lack of water they are unable to secure electric power to operate the hoist, which delays much further work in this line. A large compressor was delivered at the mine November 31 and electric pumps are expected to arrive shortly.

Blackburn, Stage, & Macomber have leased from the Black Oak Mines & Mill Co. of Soulsbyville, the Live Oak mine, which is on the south-west part of the Black Oak property. The old shaft has been cleaned out and a steam hoist and compressor installed. At a depth of 40 ft., in clearing the shaft, they cut a vein of high-grade ore, averaging from 2 to 3 ft. in width, and worth from $30 to $90 per ton. This ore is now being treated at the Black Oak mill. Prospects for a large production in the near future are very favorable.

W. J. Loring and party were in Sonora, last week, and visited the Dutch-App mines; great improvements are planned for these properties in the near future.

Sonora, December 1.

COLORADO

Boulder County

Two recent shipments of tungsten ore from the lease of the Short Bros. and another near Nederland returned as follows: 1036 lb., containing 49% WO_3, $1499 per ton; and No. 2, 5000 lb., 20.70% WO_3, $476 per ton. After paying 15% royalty to the Primos company the net profit was $1666.

The Primos Mining & Milling Co., the largest tungsten ore producer in the Boulder district, is to cancel all leases on January 1 for the purpose of increasing the royalties.

Clear Creek County

Miners in the Georgetown district have had trouble in getting a market for their zinc ore, but the Chamberlain Ore Co. announces that it will now receive the ore at its sampler.

The Princess of India adit is to be extended into Columbia mountain, and is expected to cut nearly all the best veins in the Silver Creek district.

Tungsten ores occur in the north Empire district, and when the weather improves prospecting will commence.

Gilpin County

The Colorado-Gilpin Gold & Radium Mining Co. has been organized with a capital of 1,500,000 $1 shares to operate the German Belcher property. The mines produce uranium, gold, and silver ores, and have been closed on account of local difficulties. The officers are W. Wright, president and general manager; H. F. Hoffecker, vice-president; Robert R. Gramer, secretary and treasurer; Forbes Rickard, consulting engineer; and Harry Willis, superintendent.

The new treatment-plant of the American Metals Producing Co. at Black Hawk will be ready to receive sulphide ores in January; it should be a boon to local miners. G. W. Adams is in charge.

Rich copper-gold-silver ore continues to be opened at 700 and 1000 ft. in the Carr mine on Bobtail hill. Arthur Most is manager.

Lake County (Leadville)

Pumping is in full swing again at the Penrose shaft of the Down Town mines.——Rich gold ore has been opened in the St. Louis adit; one pocket yielded 180 lb. of it. A good deal of zinc sulphide ore is also being extracted.—On No. 3 level of the Big Four 1 to 1.5 oz. gold ore is being opened.—Lessees at the Ponsardin, Pilot, Nisi Prius, Little Ellen, and others are getting satisfactory returns.

Ouray County

For the quarter ended September 30 the Camp Bird reports as follows: development, 1173 ft.; tons of broken ore in stopes, 7711 tons; ore treated, 8110 tons; revenue from bullion and concentrate, $291,786; operating charges, $86,121; profit, $160,000; also $48,000 profit from the Santa Gertrudis of Mexico. A dividend of 24c. per share was paid on November

30. On No. 7 and 9 levels some small shoots of rich ore were opened. Ore reserves contain an estimated profit of $275,000, an increase of $75,000. The October output gave a profit of $53,000 from 2730 tons of ore. It is rumored that the company is to drive an adit 9000 to 11,000 ft. from the mill to the present mine workings. This work has been contemplated for some time.

Park County

A number of Leadville men are leasing at the London mine, and 75 men are employed at the South London. The monthly output is 250 tons of 10-oz. gold ore. Prospects are excellent, and more men are to be taken on.

Summit County

An extension of dredging operations will mark future work at Breckenridge. Ground near Gold Hill is being drilled by the Tonopah Placers Co., so is another area four miles down the river by Mark G. Evans.

Teller County (Cripple Creek)

The Roosevelt drainage-tunnel was advanced 291 ft. last month. The ground was hard, and a soft dike had to be timbered. The face is 580 ft. from a point under the Elkton shaft, which is 1450 ft. deep. The flow of water is 15,400 gal. per minute.

The El Paso company and lessees produced 2100 tons of $18 to $20 ore in November. This was treated at the Golden Cycle mill at Colorado City.

On December 17 the Portland company will pay an extra dividend of 2c. per share, equal to $60,000. The total for 1915 is $360,000, and $10,117,080 to date. Grading has been started for the new sampling-plant, which is to be a duplicate of the one at Colorado Springs.

The Rubie and Lafayette mines and dump ores at Bull hill are to be treated in a new cyanide-plant being erected by the Rubie Mining & Milling Co. The mill, to be called the Worcester, will be of 30-ton capacity.

IDAHO

Shoshone County (Coeur d'Alene)

Mining and milling in the Pine Creek district will not be delayed by winter. The wagon-road is in good condition. Good work is being done at the Highland-Surprise (lead-silver), Northern Light (lead-silver-zinc), Yankee Boy (silver), Brown-Fennell (antimony-silver), Coeur d'Alene Antimony, Polaris, and Wisconsin. At the Coeur d'Alene the new mill is working, and 40 men are employed.

According to the state mine inspector, Robert N. Bell, the ore production of 1915 in the Coeur d'Alene, regardless of serious checks due to smelter contract troubles, will eclipse any previous record, not only in value but in the tonnage shipped. The largest lead producers this year, which include the properties covering the deepest developed ore channels of the district, are in splendid shape to maintain the prevailing rate of output indefinitely, provided the market is satisfactory. They already have discounted previous pessimistic estimates of their persistency at depth. He considered that the most gratifying result of the year in the Coeur d'Alene is the expanding ore resources of the region and the appreciation of the ore-bearing possibilities of the Prichard formations, which have the widest distribution of any of the district's sediments. He has been an ardent defender of the ore deposits in this formation for the last eight years, and thinks that their continued development will result in expanding the productive area of the Coeur d'Alene not less than 100%.

The Empire Copper Co. is installing a 14-drill air-compressor; the motor to drive it and the receiver are already on the ground, and the concrete foundations were put in last week. The compressor is a two-stage belt-driven Sullivan, with intercooler. Development work at the mine will be rushed as soon as the power-line is completed, which the Washington Power Co. is constructing from Cataldo, six miles distant.

Owyhee County

During the past season, Olson, Kimerlin, and Grete extracted from the old Trade Dollar workings of the Black Jack lease 48 tons of ore which yielded $41,000 net.

MICHIGAN

The Copper Country

(Special Correspondence.—There is a renewal of interest in the work at the Lake copper mine. This property was placed on the market at the time of the last boom. Its high-grade ore brought about exploration work in adjoining property. Four months ago the mine was reopened under the management of Elton W. Walker, who made such a change for the betterment in the conditions at the Mass Consolidated, and has placed that property on a paying basis. At the present time Lake is shipping ore at the rate of 8000 tons per month, this point being reached at the close of the month of November. Shipments for November were 6500 tons. The yield during November was better than 40 lb. per ton in mineral, which insures better than 25 lb. in refined copper. The interesting point at present is that more than half of the drills are working in places that were abandoned during low copper prices. A good deal of mass copper is also being extracted.

Owing to encouraging developments in the South Lake, there will probably be a resumption of work at the Adventure.

Returns from the Mohawk have been so good that a $7 dividend is expected in January. The average yield of refined copper is 21 lb. per ton of ore. Costs are lower. Development generally is excellent.

Houghton, December 8.

MISSOURI

Jasper County

The extreme northern part of the Webb City district has been practically idle for nearly seven years, but is now being pumped out. Ore occurs at 140 ft. Several mills are contemplated.

Several year's accumulation of slime from the old South Oronogo mill is to be treated in a new sludge-mill. The material will be collected by scrapers, elevated, screened, and passed over coarse and fine tables. A 35-hp. gas-engine will drive the plant. About 4% blende is expected to be recovered.

For over $100,000 the Googie zinc mine at Prosperity was sold last week by J. F. Haley and others to the National Zinc & Lead Co. of Boston. The deal includes a 200-ton mill. Ore occurs at from 171 to 185 ft. depth.

A 200-ton mill is being constructed at the Crown Nest mine at Duenweg, and one of 300-ton capacity near Lincolnville station by the Sambo company. The old Jack Harvard custom plant is to be changed to a tailing-mill by George Meese and others.

MONTANA

Silverbow County

During November the Butte & Superior mill treated 52,430 tons of ore yielding 15,050 tons of concentrate, containing 16,000,000 lb. zinc. The pay-roll was $190,000.

The Czarroman claim and the Travona fraction adjoining and south-west of the Emma mine at Butte has been purchased from the Montana Realty Co. by the Anaconda company for $225,000. The Emma lode runs through these claims; the ore contains zinc.

On December 8 a test was made at Janney, near Butte, of the new electric locomotives of the Chicago, Milwaukee & St. Paul line. The grade is 2%, the steepest between Deer Lodge and Three Forks, a distance of 113 miles. Two locomotives easily hauled 48 loaded cars, equal to 3000 tons, at 16 miles per hour.

NEVADA

Clark County

The Yellow Pine district is very prosperous at present.——The Yellow Pine Mining Co. is shipping 1500 tons of zinc ore and 200 tons of lead concentrate per month. Good ore has been opened at 800 ft. depth. Seven cents per share was paid on November 10, making $300,000 for the year.——The new 40-ton dry concentrator at the Anchor commenced on November 15 using the Stebbins machine.——The Potosi is shipping 900 tons of zinc carbonate per month, the Green Monster 300 tons, the Sutton 150 tons, and the Bonanza 250 tons.——The New Christmas Con. Mines Co. will erect a wet concentrator. ——A number of other mines are producing.

Esmeralda County

A new vein has been cut on No. 3 level of the Jumbo Extension. Assays have given up to $63 per ton. The development is considered of importance. The shoot can be worked from the Velvet shaft. The daily output of the mine is 100 tons.

At the Florence a new 75-ft. head-frame has been erected, new ore-bins, and new skips installed. Development has been resumed at 250 and 530 ft. At the old Florence Goldfield mill-site preparations have been started for the erection of a 150-ton flotation-plant. The Nevada Metal Extraction Co., is composed of Nevada metallurgists and mining men, headed by F. A. Mead. A three-year lease has been secured on the Florence dumps, which contain 55,000 tons, mainly from old leases. Janney machines will be used.

Humboldt County

The president and general manager of the Nevada Packard Mines Co., Mark Walser, reports the finding of seven feet of sulphide ore at the extreme end of the north-east drift off adit C. Samples have been sent to San Francisco to be assayed and it is expected that the ore will be worth $100 per ton. A large slab of rock, thought to have been the end of the ore in the drift, which fell of its own weight, uncovered the deposit.

During the three months ended with October, the Seven Troughs Coalition company's revenue was $160,990. The total expense was $82,348, and profit $78,642. In four months the ore production was 1785 tons containing $186,550.

Lyon County

The superintendent of the Nevada-Douglas Copper Co. reports that the treatment of ore from the first charge of the Wedge furnaces gave an extraction of 90% by leaching. The furnaces are operating splendidly. The feeding is at the rate of about 80 tons per day. The discharge shows a perfectly roasted product. Sulphur gases from the furnaces are being used in leaching oxidized ore.

Mineral County

In the Sodaville district the development of tungsten properties occupies first place. A California firm is working the property of C. E. Noble, employing over 30 men. The old Acme mill is concentrating the ore. The whole adjacent area has been staked.

Bismuth has been found by W. R. Smith in the Cedar range, near the Copper Contact mine.

Nye County

During the week ended December 11, six companies and numerous lessees at Tonopah produced 10,114 tons of ore worth $208,012.

Silver shipped by the Belmont amounted to 149,499 oz., produced by the plants at Tonopah and Millers.

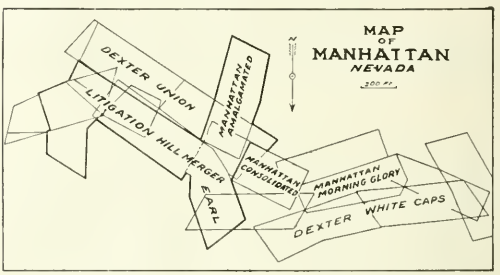
The West End will pay 5c. per share, equal to $89,424; the total to date is $536,546. Development continues good.

The Extension dispatched bullion worth $72,800, and 325 tons of concentrate valued at $11,700; this is a record shipment. The mill treats 1850 tons of ore per week. The lode from 850 to 1350 ft. continues to produce plenty of good ore.

In the suit of the Extension *v.* the West End, Judge Mark R. Averill on December 7 made an order modifying the restraining order and temporary injunction issued on July 17 against the defendent, by which the latter can resume operations in the disputed ground in order to determine what is the condition of the vein.

The Tonopah Mining Co. is preparing to develop the old California property, which adjoins the Jim Butler on the south.

At the Union Amalgamated Co.'s property at Manhattan, the preparatory work at the Earl and Merger properties necessary



before the starting of the company's mill has been about completed. At the outset it was found that the Earl's working shaft had caved from between the 75 and 150-ft. levels. This necessitated re-timbering the shaft for 75 ft., and 'mucking' the caved material from the entire shaft to the 350-ft. level. This has been slow work due to the decayed shaft timbers, track, and piping being all mixed with the waste. However, the cave proved somewhat a blessing in disguise, as the caved ground has left exposed a very promising shoot of ore in the hanging wall.

The Litigation Hill Merger shaft has been pumped out to 400 ft. This has drained the Earl and Merger workings. All is in readiness for underground work. The mill will commence on December 15. The orebodies have been sampled.

At the Big Pine a large lode has been cut in the south glory-hole.

From the Train-Chase lease on Mustang hill, 36 tons yielded $87.60 per ton by amalgamation at the War Eagle mill. A previous lot gave $100 per ton. Three shoots have been exposed in shaft-sinking.

The White Caps Mining Co. has just distributed checks making the final payment in the liquidation of the debts taken over from the old company at the time of the re-organization. It is understood that company operations are to be started shortly, the first mining work to be the sinking of the vertical shaft for another 100 feet.

NEW MEXICO

Grant County

(Special Correspondence.)—The Empire Zinc Co. is prosecuting a vigorous campaign of development at its mines at Hanover. The erection of a 125-ton daily capacity electrostatic dry concentration plant is well under way. The company's new central power-plant has been erected and is nearly ready. A number of residences for the executive staff, and good houses for general help, are being erected. This mine has been a consistent producer of zinc ore for 25 years, and from its present physical condition is apparently entering its period of greatest production. Present shipments are 1200 tons per month of high-grade zinc carbonate ore to the company's smelter at Collinsville, Oklahoma.

J. W. Bible has the Modoc mine of the Phelps Dodge Co. under lease. He has shipped 40 cars of copper-iron ore, containing from 2.5 to 5% copper, and still has considerable ore

blocked out ready for mining and shipment.

It is said that the efforts of the U. S. Copper Co. to finance its mine have been successful, and that work will be resumed on the property in the near future. The mine has produced considerable copper, and the owners claim to have shipping ore developed.

The Republic Mining & Milling Co., operating property under lease and option adjoining that of the Empire Zinc, recently shipped a carload of high-grade zinc carbonate ore, which netted nearly $40 per ton. The car was shipped to the American Metal Co., Ltd., Chanute, Kansas.

The Colorado Fuel & Iron Co. has men at work on its leased properties north of Hanover. It is reported that extensive operations will begin about January 1.

Lee and Cameron of El Paso have the Honey Comb property of the Hermoso Copper Co. under lease. They have opened good ore. Heavy ground is temporarily delaying development and ore shipment.

McKenna and Gerhart recently shipped a carload of copper ore from their property at Humbolt mountain.

Hanover, December 6.

SOUTH DAKOTA

Lawrence County

On December 27 the Homestake company will pay 65c., and an extra dividend of $1 per share. The total for this year is $8.80 per share, equal to $2,210,208. To date the payments are $167.40 per share, or $35,525,981.

TEXAS

Culberson County

(Special Correspondence.)—Good progress is being made in plans to develop on an extensive scale the large surface deposit of sulphur situated in the north-eastern part of this county, not far from the New Mexico border, by G. A. Plummer of Beaumont and a New York syndicate. Considerable preliminary work has already been done at the property, and it is announced that the work planned will cost $300,000. A direct shipping outlet for the sulphur will be obtained by the construction of a railroad to Orla or some other point on the Pecos Valley line of the Atchison, Topeka & Santa Fe; only 15 miles of track will be necessary to do this. The existence of large deposits of sulphur in this county has long been known, but this is the first time any well organized plan of developing them has been attempted.

Orla, December 2.

UTAH

Carbon County

In the Colorado School of Mines *Magazine* for December features of coal mining in Utah, principally in this county, are described by A. C. Watts of the Utah Fuel Co. The known workable beds cover 15,200 sq. miles, and contain 197,000,000,000 tons of coal. An analysis of some of the coal shows 52.73% fixed carbon, 5.45% ash, and 13,412 b.t.u. heating value. The seams are thick, and the general system of mining is by room and pillar. Aerial tramways, steel tipples, and steam turbo-generators are part of the surface equipments. First-aid is an important department, also sociological work.

Juab County

Ore containing 100 oz. silver per ton is being extracted from the Lower Mammoth 1000-ft. level. The first dividend for some years is to be paid this month.

Lessees at the Gemini have received $82,000 during the period that the mine has been opened this year.

Salt Lake County

The Karns tunnelling-machine was shown in working condition at the Maxfield mine, Big Cottonwood district, on December 5. The air pressure was 90 lb., and a hole 12-in. diameter was drilled two feet in 40 minutes. It is claimed that the cost of driving is reduced 50%, and the speed is 50% greater. The adit is 7 by 9 ft. in the clear.

At the Wasatch property the company is spending $7500 on a new pipe-line at the power-plant to increase its capacity by 500 hp. The power required by other companies in the Little Cottonwood district is increasing, hence this addition.

In the Sells mine the shoot has been opened for 140 ft., and is from 7 to 12 ft. wide, worth from $15 to $45 per ton. It is one of the best orebodies in the district. A. O. Jacobson is manager.

At 250 ft., in the Langdon fissure, the South Hecla has cut high-grade ore.

Summit County

There are more properties being worked in the Park City district than for years. The product for 11 months totals 91,477 tons, against 74,697 tons in 1914.

The Daly-Judge company is in a comfortable position, according to the general manager, George W. Lambourne. Profits distributed this year total $300,000, and the balance at the end of 1915 will be over $600,000, more than enough to pay next year's dividends. The monthly output of zinc concentrate is 600 tons. The rise in silver adds largely to the profits.

The following dividends will be paid by Utah companies during December:

Utah Apex	$ 66,000
Prince Consolidated (Nevada)	50,000
May Day	24,000
Utah Consolidated	150,000
Lower Mammoth	10,000
Silver King Consolidated	63,750
Eagle & Blue Bell	44,657
Daly-Judge	105,000
Grand Central	12,500
Mammoth	20,000
Total	$545,907

The Silver King Coalition will distribute 15c., equal $187,500, on January 1. Its total will be $13,958,000.

The total for 1915 is as under :

	Per Share.	Paid 1915.
Bingham-New Haven	$ .80	$ 227,951
Chief Consolidated	.10	88,000
Cardiff	.25	125,000
Daly-Judge	1.00	300,000
Duluth and Utah Dev.	.08	4,500
Eagle & Blue Bell	.15	135,000
Grand Central	.02	12,500
Iron Blossom	.30	300,000
Lakeview Mining	.10	46,000
Lower Mammoth	.01	10,000
May Day	.11	88,000
Mammoth	.05	20,000
*Mt. Aetna Gold	.02	5,000
Silver King Con.	.40	252,500
†Silver King Coalition	.60	750,000
Utah Consolidated	2.00	600,000
Utah-Apex	.25	126,000
Utah Copper	4.25	6,809,700
Total		$9,900,151

*Estimated.

†Inclusive payment January 1.

This is $3,000,000 more than in 1914.

CANADA

British Columbia

The net operating profit of the Standard Silver-Lead mine at Ainsworth, controlled by Spokane capital, was $112,617

during October, comparing with $88,067 in September, according to the monthly report issued by Charles Hussey, secretary, from the company's offices at Spokane. The balance on hand at October 31 was $287,358, against $224,779 at the close of September. The sale of zinc, which was started at the opening of October, accounted for $24,834. Preliminary settlement for 1485 tons of ore received during October amounted to $113,399. The company paid dividend No. 34 in October, amounting to $50,000. A similar dividend will be paid for November, and in December two disbursements of $50,000 have been declared. In the recapitulation for the month, the report shows $224,721 in the bank, and credits $94,874 for ore shipped and not settled for.

ONTARIO

The provincial Bureau of Mines reports the following production for the nine months ended September 30:

	Value.	Same period 1914.
Gold	$5,826,941	+$1,884,093
Silver	8,030,469	—2,051,760
Copper	2,024,658	+359,762
Nickel	5,369,536	+1,345,980
Iron ore	601,044	+221,126
Pig-iron	4,510,906	—1,933,307
Cobalt ore	12,472	—14,091
Cobalt metal	66,552	+66,552
Nickel metal	4,762	+4,762
Cobalt and nickel oxides, etc.	124,088	—331,403

During the six months ended September 30 the Dome output was 162,363 tons of ore averaging $4.42 per ton. The November yield was 28,600 tons averaging $5.59 per ton.

On December 2 the Hollinger paid its monthly dividend of $120,000. This makes 44% for 11 months, equal to $1,320,000, and 135% to date, or $4,050,000. The yield for the four weeks ended November 4 was 28,401 tons of $10.34 ore, and a profit of $184,769. The cost was $3.29 per ton.

On January 1 the McKinley-Darragh will pay 3%, equal to $67,431. This makes $4,471,890 to date.

MEXICO

American mining interests in Mexico are much disturbed over the recent action of the *de facto* government in increasing the tax on their properties. Of course, the increase applies to all mine holdings, irrespective of whether they are foreign or native owned, but inasmuch as Americans have large investments in the industry the burden will fall chiefly on them. The present tax is ₱60 for mining claims of 10 *pertenencias*, which is equal to 20¾ acres. Claims in excess of this acreage are taxed ₱30 for each additional 10 *pertenencias*. The new tax, which is designated to discourage small holdings, it is claimed, is graduated and is higher as the holdings increase. It fixes the tax at ₱120 for each 10 *pertenencias*, ₱270 for 240 *pertenencias*, ₱810 for 1350 *pertenencias*, and so on up. All claims in excess of 50 *pertenencias* are taxed ₱24 per *pertenencia*. Under the old law these taxes were payable in either gold, silver, or Mexican currency. Under the new law only Mexican gold or its equivalent in American money at the regular exchange basis of 2 to 1 will be accepted. The new law is to go into effect on March 1, 1916.

SONORA

The Rodriguez forces have been completely defeated, and further large battles are not expected in this state. All saloons have been closed.

Soon after the Americans left El Tigre the Rodriguez forces sacked the place, including the company's stores and houses, but the plant was not damaged.

It was expected that the Greene-Cananea mines and works would resume on December 11; also the Democrata company in the same district.

PERSONAL

ROBERT C. CANBY is visiting Berkeley.

S. F. SHAW has gone to San Antonio, Texas.

J. H. MACKENZIE is returning from New York.

WILLIAM FORSTNER has returned from Tonopah.

J. M. CALLOW was here from Salt Lake City during the week.

THOS. H. LEGGETT has returned to New York for Christmas.

F. C. BROWN, the inventor of the Pachuca agitator, is at Atlanta, Idaho.

W. H. LANAGAN has returned to San Francisco from the Cariboo district, B. C.

H. C. ENOS has just returned to Colorado after completing examinations in Utah.

HORACE M. WILSON is leaving California to return to Colombia, by way of New York.

L. H. METZGER, formerly at Goldfield, Nevada, has joined the staff of the Alaska Treadwell company at Juneau.

ALFRED TELLMAN is conducting concentration experiments for the Ridder Mining Co. in the Altai region, Siberia.

THOS. T. READ has gone to New York, where he will join the engineering staff of the New Jersey Zinc Company.

O. W. VAN LAW, second vice-president of the U. S. Smelting, Refining & Mining Co., was recently at Salt Lake City.

GEORGE H. GARREY passed through San Francisco the first of the week on his way from Colorado and Nevada to Seattle.

M. F. CHASE and W. D. MAIN severed their connections with the Mineral Point Zinc Co. on December 1. They have offices in the Marquette building, Chicago.

J. D. CONNOR, metallurgist for the South Australian government, has completed his inspection of copper-leaching plants and is returning to Australia next week *via* Vancouver.

D. D. CAIRNES, geologist in the Yukon for the Canadian government, has accepted the chair of assistant professor of geology and mineralogy in the University of British Columbia.

FRED B. CLOSE, who has been active in the development work at the White Pine Extension property, Michigan, will be superintendent in charge. WILLIAM R. BOLLEY, formerly superintendent of the Baltic mine of the Copper Range Consolidated, will be assistant superintendent.

FREDERICK G. CLAPP, managing geologist of the Associated Geological Engineers, has recently completed some explorations in Texas and has gone to Elgin, Kansas. CLYDE T. GRISWOLD of the mining department in the Carnegie Institute of Technology, and RALPH W. RICHARDS of Washington, D. C., are included in the party.

JAMES MAPES DODGE, chairman of the board of the Link-Belt Co., died at his home in Philadelphia on December 4. Mr. Dodge was one of the pioneers in the conveying and elevating systems, and his inventive genius was a conspicuous factor in its broad and successful development. Among his important inventions and improvements were those relating to the construction and manufacture of silent-chain. He was a member of many societies.

The School of Mines of the University of Idaho will offer, during January and February 1916, a short course for prospectors, miners, and millmen. The subjects treated will include prospecting, mineralogy, mining geology, mining, metallurgy, ore-dressing, concentration, and milling. There are no fees in connection with any of these courses, and instruction is free. The work is laid out especially for mature men who desire to make the most of their time during this brief period.

THE METAL MARKET

METAL PRICES.

San Francisco, December 15.

	Cents per pound.
Antimony	40
Electrolytic copper	20.75
Pig lead	5.65—5.85
Quicksilver (per flask)	$130
Spelter	20
Tin	40
Zinc-dust, 100-kg. zinc-lined cases	30

ORE PRICES

San Francisco, December 15.

Antimony: market weaker; 50% product, per unit	$ 2
Antimony: 50% product, per unit	$ 2
Chrome: 52% chromic oxide and 2% silica per ton	12
Magnesite: plastic, no iron and lime, calcined, per ton	55
Magnesite: refractory, up to 7% iron, calcined, per ton	30-35
Manganese, 50% metal, 8% silica, per ton, f.o.b. cars, S. F.	12
Tungsten: minimum 65% WO_3 per unit for spot	$35—45

New York, December 10.

Antimony: per unit, $2.55.

Tungsten: 60%, $50 for deliveries in first quarter of 1916.

Manganese: Difficulty is being experienced in getting manganese ore from Brazil because of the scarcity of ships. The matter is a serious one with steel makers, in view of the lessened supply of ferro-manganese now coming from England.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 16.—The copper market is firm owing to advance in London; strength in London explains the increase in lead; the zinc market is excited, there are few buyers, but London inspires strength.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec. 9	56.00	Nov. 3	49.37
" 10	55.75	" 10	50.02
" 11	56.00	" 17	50.46
" 12 Sunday		" 24	52.35
" 13	55.62	Dec. 1	56.27
" 14	55.62	" 8	55.54
" 15	55.00	" 15	55.66

Monthly averages.

	1911.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	51.88
June	56.43	49.03	Dec.	49.27	....

The silver market appears to be somewhat unsettled, but is strong. European purchases are responsible for later strength. During the week ended December 4 Cobalt companies shipped to London 304,322 oz. The Nipissing from December 1 to 9 sent 510,603 ounces.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Dec. 9	19.50	Nov. 3	17.89
" 10	19.50	" 10	18.08
" 11	19.50	" 17	18.58
" 12 Sunday		" 24	19.58
" 13	19.50	Dec. 1	19.77
" 14	19.50	" 8	19.60
" 15	19.75	" 15	19.54

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	18.88
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended December 8 totaled 6,370,971 lb. valued at $1,168,633. To France went 3,547,331 lb., and 1,120,459 lb. to Russia. Imports amounted to 4,929,999 lb. worth $665,581. Chile sent 966,498 lb. and Peru 2,842,540 pounds.

In November, Braden yielded 3,684,000 lb. and Old Dominion 2,443,000 lb.; in October, Granby produced 4,124,499 pounds.

Dividends declared include $1 by Chino, 37½ and 12½c. by the Nevada Con., 50c. by Ray, and $1 and 50c. per share by Utah Copper. These four companies have cash and metal in process paid for totaling $25,000,000. The Calumet & Arizona will pay $1.25 per share.

The Copper Range Co. resumes dividends, first since October 1913, by paying $3.——Quincy is expected to produce 21,000,000 lb. this year; the monthly profit is $125,000 from 105,000 tons of ore.——The Lake Copper Co. is making a profit at last, namely, $10,000 per month.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Dec. 9	15.00	Nov. 3	14.92
" 10	15.50	" 10	15.63
" 11	15.50	" 17	17.02
" 12 Sunday		" 24	18.58
" 13	16.00	Dec. 1	18.52
" 14	16.75	" 8	15.83
" 15	17.50	" 15	16.04

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	6.01	17.20
June	4.84	22.20	Dec.	5.40	....

Butte & Superior has declared its quarterly dividend of 50c. and an extra of $7.50 per share. The total for 1915 is $18. against $2.25 in 1914.

Ore prices at Joplin, Missouri, were $15 per ton lower last week, 60% product realizing from $65 to $90. The output of the region was 4232 tons blende, 220 tons calamine, and 1265 tons lead, averaging $77.70, $63.09, and $71.64 per ton, respectively. The total value was $432,362, and for 50 weeks, $24,-003,765.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec. 9	5.25	Nov. 3	4.87
" 10	5.25	" 10	5.02
" 11	5.25	" 17	5.20
" 12 Sunday		" 24	5.25
" 13	5.25	Dec. 1	5.25
" 14	5.40	" 8	5.25
" 15	5.40	" 15	5.30

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	5.15
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Date.		Dec. 1	105.00
Nov. 17	100.00	" 8	115.00
" 24	105.00	" 15	130.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	101.50
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	39.50
June	30.72	40.26	Dec.	33.60	....

There has been a revival of antimony mining in Japan. Three mines produce 50 tons per month, while consumption of that country is 450 to 500 tons.

Eastern Metal Market

New York, December 10.

Pronounced quiet has been the feature of the past week, and it is likely that 1915 will see no more extensive buying. Consumers are well supplied, and furthermore, they are never inclined to be active purchasers at this season. The London market shows an easier trend also. Some of the smaller copper producers have lowered their asking price, while second-hands have solicited business at 19.50c., cash, or less. All the indications point to fewer new war orders, although finishing those in hand is a gigantic task. Zinc dropped over 3c. per lb. in the first 10 days of this month, but now shows a little renewed strength. Lead is in much the same position as copper; the leading interest holding up its price, while re-sellers are offering concessions. Business in tin has been confined to small lots of spot. Antimony is easier. Aluminum is quoted at 58 to 59c. for the purest grade.

Lake Superior iron ore next year will be 75c. per ton higher than the 1915 schedule. It is predicted that 1916 will see a shortage in iron ore, and the production of pig-iron may be restricted. Ore shippers are having difficulty in chartering vessels for next season. The production in pig-iron in November was at the rate of 101,244 tons per day, or 3,037,308 gross tons in the 30 days, against 3,125,491 tons in October, or 100,822 tons per day. The pace at which blast-furnaces were driven in October cannot be long maintained, as the strain is too great. Meanwhile, the prices of steel continue to soar. The situation presents various irregularities, such, for instance, as the Middle West turning to the East for steel. In the export trade all sorts of fancy prices are paid for finished or semi-finished steel. Pig-iron continues to advance. Some idea of the foreign demand for steel is afforded by the one item of 500,000 tons of shell steel which French consumers are seeking to buy in this country. Deliveries are to be made in 1916, regardless of the ending of the War. Meanwhile, domestic business continues to improve.

COPPER

The copper market has become very dull, and probably will remain so for the remainder of this year, a situation which is likely to prevail with the other metals as well. Electrolytic is lower at London, the quotation on December 10 being £97 10s. Of course, no one is surprised at the present state of the market. Heavy buying cannot go on continuously, and in the past few weeks many millions of pounds have been contracted for, some to be delivered in the second quarter of next year. Another point to be considered is the fact that quiet always prevails in the markets around the Christmas holidays. The producers have held to 19.75 to 20c., cash, New York, as they well can afford to do in view of their sold-up state, but second-hands have sought to induce buying by offering concessions and down to 19.50c., cash. Some say that 19.37½c. had been quoted. Even these prices, however, can not change the tenor of the market. The brass-mills continue to be very busy, are extending their facilities, and new enterprises are projected to enable the handling of war orders. These orders have reached flood tide, and from this time on fewer will be placed. So far this month exports have made a good showing, their total up to to-day, being 15,444 tons, or about at the rate of 1500 tons per day.

ZINC

In the first 10 days of this month the quotations for zinc declined over 3c. per pound, and demand slacked off to nothing. The New York price for spot today, December 10, stands at 15.50c., and at St. Louis about ½c. less. On Monday of this week, when 15c. was quoted there were a few large inquiries before the trade, and with the lower prices activity on the part of the galvanizers was looked for. A good part of the galvanizing trade has only bought as necessity compelled them to cover contracts on their books. Despite the inquiries referred to, the market, generally, has been one of quiet, and waiting. The London market has shown a much weaker trend, losing £7 on spot, and £9 in futures, in three days. A large amount of inconsistency is shown with regard to spelter. It is certain that buyers have found it difficult to find spot and near-by metal, yet many of the trade insist that there is plenty of the metal. Opposed to their view is the fact that the brass-mills are using the metal at the rate of about 200,000 tons per year, whereas they ordinarily consume about 80,000 tons. Then there are the large exports which from December 1 to 10 totaled 2963 tons. From this time on, however, Russian buying will be less of a factor, inasmuch as the port of Archangel will soon be closed to navigation. Consumers filled their requirements, for a time, on the recent upward movement, and it is doubtful if there will be any considerable activity this year, unless the galvanizers become active, and this they will not do unless quotations stay within what is considered reasonable. January deliveries were to be had, and some were taken, late this week, at 14.25c. St. Louis, and first quarter at 13.25c. Consumers show a disposition, however, to refrain from buying far ahead. The London market for spot was quoted on December 10 at £82, and for futures, at £69. The quotation for sheet-zinc, carload lots, f.o.b. mill, continues at 22c., subject to a discount of 8% for cash.

LEAD

The situation in lead much resembles that in copper; producers being well sold, and consumers well filled up. The leading interest has adhered to 5.25c. New York. The outside St. Louis quotations are a little easier; the leading interest quoting 5.17½c., while others ask 5.15c. The offerings at concessions, however, have not embraced any large quantities and they would soon disappear were buying to become at all brisk. Exports are restricted by the scarcity and high cost of ocean-freight space, added to which is difficulty in getting shipments to New York. Some of the railroads have declared embargoes on freight of various kinds, lead included. Thousands of cars encumber the railroad sidings. The inability to transfer freight to ships not only congests the freight-yards, but ties up the cars which are needed elsewhere. Exports this month, December 1 to 10, total 1740 tons.

TIN

The market has continued dull with practically the only business done being in small lots of spot. The quotation for prompt metal dropped to 37.25c., December 7, and today, the 10th, is 38c. As heretofore said, the market is paying the penalty of the many false reports circulated in recent weeks, which have destroyed the confidence of consumers. The quiet is expected to last until after the holidays, except for a possible spurt just before Christmas. The steamer *Indrawadi*, which was due on November 20, but which ran short of coal and put in at Bermuda, has at last arrived bringing 1100 tons, an exceptionally large shipment. Arrivals of the month, up to the 10th, totaled 2725 tons, and there was afloat on that day 5833 tons. Today, tin is cheap.

ANTIMONY

Recent arrivals have made the market easier, and spot antimony, duty paid, is now quoted at 39 to 39.50c. The demand has not been noteworthy. Both American and Chinese and Japanese grades are on the same level.

ALUMINUM

For No. 1 virgin metal, 99% pure, the quotations are 58 to 59c., and for 98 to 99%, 56 to 58c. In the general situation there is no change, and new consumers have to look long to fill their requirements.

MINING DECISIONS

Coal Lease—Rents Defined

Held, that the word 'rents' in a coal lease does not include a right-of-way charge.

Tustin *v.* Philadelphia, etc., Coal & Iron Co. (Pennsylvania), 95 Atlantic, 595. July 31, 1915.

Oil Lease—Suit for Royalties—Parties

In a suit by lessor against lessee for an accounting of royalties on oils produced, the assignee of a part of the royalty oils is a necessary party thereto, as well as all other parties whose interests are involved therein.

Gurcher *v.* South Penn. Oil Co. (West Virginia), 86 Southeastern, 560. September 28, 1915.

Rights of Surface Owners to Underlying Strata

A landowner who has conveyed the underlying coal to another is entitled to drill a well through that coal in order to obtain a water supply from the strata underneath, and if the coal-owner negligently destroys the well-casing he is liable for damages.

Pennsylvania Central Brewing Co. *v.* Lehigh Valley Coal Co. (Pennsylvania), 95 Atlantic, 471. July 3, 1915.

Coal Lease—Mistake of Law

Plaintiffs paid royalties under a coal lease for many years, and then discovered that they themselves owned part of the coal upon which they had been paying royalties to their lessor, and refused to pay further royalties under the lease until they had reimbursed themselves for this mistake. Held, that inasmuch as their mistake as to title was a mistake of law, all the facts having been in their possession at the date at which the lease was made, a court of equity could not relieve them from the consequences of their error or permit such reimbursement at the lessor's expense.

Clark *v.* Lehigh, etc., Coal Co. (Pennsylvania), 95 Atlantic, 462. July 3, 1915.

Mining Claim—Quiet Title Suit—Limitations

Plaintiff, being in continuous adverse possession of a mining claim for which defendants had applied for patent, filed an adverse claim and brought suit thereon. This suit was afterward dismissed upon an agreement by defendants to except the claim from their patent application. Plaintiff's attorney died and the defendants failed to live up to their agreement to except the claim in question from their patent application, and a receiver's receipt was issued. Plaintiff then filed a protest with the General Land Office against issuance of a patent, and commenced another suit to establish title. Held, on appeal from an order sustaining a demurrer, that the suit was a proper one; that notwithstanding the expiration of the time in which suit on a regular adverse claim could be begun, plaintiff was entitled to maintain a quiet title suit based on his own adverse possession and defendant's bad faith.

Poncia *v.* Eagle (Idaho), 152 Pacific, 208. October 9, 1915.

Pure antimony is a brilliant silver-white metal. It is brittle and soft, being slightly harder than copper. Commercial antimony is generally contaminated with small amounts of sulphur, arsenic, lead, copper, and iron, and these impurities give it a bluish tinge. The main use of antimony is in the form of alloys, the principal ones being pewter, anti-friction metal, type-metal, and hard lead.

BOOK REVIEWS

Safety in the Foundry. By Magnus W. Alexander. P. 187. Illustrated. National Founders' Association, Chicago. For sale by the Mining and Scientific Press. Price, $1.50.

Mining companies whose operations are of any considerable extent usually have foundries in connection with their machine-shops. Many accidents are possible in a foundry, such as burning and falling weights, and troubles arising from dust and steam. This is the first and only handbook of its kind to be published, and is the result of the investigations made by the National Founders' Association Committee on Safety and Sanitation during three years. The work is primarily arranged for the purpose of safe-guarding the employee and promoting his welfare, incidentally reducing compensation risks. Practical foundry-men are said to have commended the discussions therein. Some of the topics are on signs, yards, light, ventilation, cranes, trucks, ladles, crucibles, dusty work, tools, clothing, goggles, and first-aid. Mine safety departments would do well to secure a copy of this work.

Winning a Fortune. By Lewis W. Klinker. P. 477. Ill. W. B. Conkey Company.

It is not often that the Mining and Scientific Press reviews a work of fiction. This Californian story by Mr. Klinker is an exception. As the author states in his introduction, "To make money and to win a fortune quickly has a fascination for people; mining is today almost the only field left open for the realization of such an ambition. It is my purpose to combine some interesting facts with fiction and romance to make a story at once useful and entertaining. The facts, as to the names of the placer mines, are real, as is the amount of gold produced from them, which I know from personal experience in the Sierra Nevada region." Topics touched upon in the exciting account of adventures among Indians, rogues, and all kinds of frontier hardships, include crossing the plains in wagons in early days, stopping of hydraulic mining by the courts, building of the railroads, redemption of swamp-lands. In brief, the book is a thrilling tale of all kinds of exploits and experiences in the opening of a new country. Deserving of particular mention are the five illustrations of incidents in the story, drawn by the author's daughter, Miss Orpha Mae Klinker. The book is an agreeable reminder that romance and freshness of vision are not yet dead in the world.

Recent Publications

Coal Mining in Illinois. By S. O. Andros. Bulletin 13. P. 250. Ill., index. University of Illinois, Urbana, 1915.

Annual Report of the Secretary of the Interior for the fiscal year ended June 30, 1915. P. 221. Illustrated. Washington, D. C., 1915. Development of mineral resources covers 57 pages.

U. S. Bureau of Mines, Washington, D. C., 1915.

Technical Papers:

Determination of Nitrogen in Coal. By Arno C. Fieldner and Carl A. Taylor. No. 64. P. 25. Illustrated.

The Explosibility of Acetylene. By George A. Burrell and G. G. Oberfell. No. 112. P. 14.

Miners' Wash and Change Houses. By Joseph H. White. No. 116. P. 27. Illustrated.

Notes on the Use of Low-Grade Fuel in Europe. By R. H. Fernald. No. 123. P. 37. Illustrated.

Abstracts from the above papers will appear in the Press from time to time.

NEW MACHINES AND DEVICES

Information based on letters and catalogues from manufacturers.

Commercial Paragraphs

STANDARD SPIRAL PIPE WORKS, Chicago, has published a circular devoted to the features and economic advantages of this company's products.

The Sheldon 'car-mover' and Dayton 'car-wrench' are two useful devices which the STEPHENS-ADAMSON MANUFACTURING Co., Aurora, Illinois, is offering.

The WAGNER ELECTRIC MANUFACTURING Co., St. Louis, Missouri, has compiled a series of small illustrated bulletins describing in detail the various products of this company.

Bulletin No. 1075-A of the ALLIS-CHALMERS MANUFACTURING Co. deals with belted alternating-current generators, types AB and AH. Many interesting details are given on their construction.

The TOLEDO SCALE Co. announces that H. O. Hem, formerly of Kansas City, has become a member of its engineering staff in the capacity of consulting engineer, and is now located in Toledo, Ohio.

Catalogue No. 2 of the CLARAGE FAN Co., Kalamazoo, Michigan, is descriptive of the products of this company, and contains a large amount of data on the construction and operation of the various types of fans manufactured by it.

The J. D. FATE Co., Plymouth, Ohio, has recently circulated an attractive folder entitled 'The Plymouth Gasoline Industrial Locomotive Cuts Haulage Costs.' The folder sets forth the many claims of superiority for this type of locomotive.

Circular A of the ST. LOUIS WELL MACHINE & TOOL Co., St. Louis, Missouri, is devoted to the well drilling and prospecting machinery manufactured by this company. The booklet is fully illustrated and contains details regarding the construction and operation of this equipment.

CLEVELAND BRONZE BRASS WORKS, Cleveland, Ohio, has for distribution an illustrated pamphlet descriptive of the 'Acimet' valves manufactured by this company. This type is acid-proof and particularly adopted to the requirements of acid manufacturers and all work requiring non-corrosive valves.

'The Terry Turbine' is the title of a new bulletin just issued by THE TERRY STEAM TURBINE Co., of Hartford, Connecticut, giving a general description of the various turbine applications, and dealing particularly with various kinds of high, low and mixed-pressure turbines. The publication is well illustrated.

The Luckle 2 Tungsten Co., operating a mill near Boulder, Colorado, has given the DENVER QUARTZ MILL & CRUSHER Co., of Denver, an order for a Denver steel crusher and a Denver quartz mill. The Denver company supplied the equipment now in use in this mill some five years ago, and this repeat order is to enable the mining company to take care of the increased quantity of ore caused by the high price of tungsten.

SAUERMAN BROS., Monadnock Block, Chicago, Illinois, has for distribution an instructive catalogue devoted to the application of the Shearer & Mayer drag-line cable-way to various types of excavation. The uses of this excavator in mining work are varied, and are particularly adapted to the working of placer deposits, recovery of tailing, and open-cut excavations. By this means large quantities are being handled at a cost which is claimed to make the drag-line excavator superior to other established methods of excavation. The catalogue is fully illustrated, and shows a wide variety of Shearer & Mayer installations.

The No. 34 Myers type dry concentrator is a new type of machine which has been developed by the SUTTON, STEELE & STEELE Co., Denver, Colorado. The new table is a modification of the older type of table manufactured by this company, is smaller, more compact, and of greater efficiency. The No. 72 machine is the larger machine, and is of much larger capacity than the No. 34, although adapted to the same class of work. A bulletin has been issued describing the construction and operation of these two machines.

The WESTERN ELECTRIC Co., New York, sends us the following: On November 18 all of the assets of the Western Electric Co. of Illinois were acquired by transfer to a company chartered under the laws of the state of New York, to be known as Western Electric Co., Inc. In the construction of the Hell Gate bridge over the East river, New York, a steel arch 1017 ft. long, the greatest in the world, the company's telephones played an important part. Owing to increased business the company has moved its Detroit headquarters to a new building of 50,000 sq. ft. floor space, and 54,000 sq. ft. in the yard.

A recent circular from E. E. WHITE, Ishpeming, Michigan, gives a few notes on the MAAS patent drill-hole compass for surveying bore-holes. Twelve of these have been rented to prominent exploration companies in the United States, Canada, and Russia, which are getting good results. The compass is placed in a thermos bottle or glass tube with hot liquid gelatine and lowered in a water-tight phosphor-bronze case, with a tube containing hydrofluoric acid. When the gelatine is cold the rods are pulled, the direction of the needle is marked on the tube which contained the acid, and direction and inclination of the hole determined from this tube in a goniometer. There is nothing to get out of order and the compass can be used by any drill foreman, the mark and etching on the tube making a permanent record of direction and inclination. The compass will survey drill-holes to a depth of 3000 ft. for both direction and inclination in the time necessary to test for inclination only. A price-list of supplies is given.

The WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburg, Pa., sends the following notes:

There have been a number of changes of personnel in the supply department.

Paul M. Lincoln, whose term as president of the American Institute of Electrical Engineers, expired July 1, 1915, and who has for a number of years been prominently identified with the engineering department of the Westinghouse company, has resigned his position with the company to devote his time to the manufacture of a meter which he has recently invented. Mr. Lincoln graduated from Ohio State University in 1892.

A new refrigerating-machine, invented by Maurice Le Blanc, who designed the well-known Le Blanc condenser, was tested before prominent engineers at East Pittsburg on October 29. A special feature of the machine is the absence of all chemicals or compressed gases, such as carbon dioxide, ammonia, or sulphur dioxide, which are generally used in connection with refrigeration. This point will readily be appreciated when the present scarcity of chemicals due to the present War is recalled. The presence of tanks of carbon dioxide under pressure is always an element of danger. The machine is made by the WESTINGHOUSE MACHINE Co.

EDITORIAL

T. A. RICKARD, Editor

NIKOLA TESLA is said to have invented a manless air-ship controlled by wireless electricity capable of going 300 miles per hour. All of us have heard of the wireless-controlled torpedo. Such inventions promise to do more to render warfare impossible than the speeches of pacifists or the argosies of perambulator-manufacturers.

CHRISTMAS in this year of grace is a satire. The world has its eyes not upon Bethlehem of Judæa but Bethlehem in Pennsylvania. The little town with its babe in the manger is replaced by a vast manufactory of death-dealing implements. Charles M. Schwab is the great protagonist of the present era. Christianity may well grieve and civilization slink away ashamed.

INCREASED cost to the amount of $21,000,000 has been incurred by the Post-Office Department during the last fiscal year on account of the War. Good results are claimed for the efforts made to stop fraudulent advertising and circularizing through the mail. Undoubtedly the Post-Office has done good work in checking predatory promotion of worthless mining schemes.

WHETHER New York becomes the money-centre of the world after the War will depend upon American investments in foreign countries. London is the great financial centre because so large a part of its investment is done abroad, for lack of adequate scope at home. The United States covers a continent still in course of development, so that much money can be used domestically to advantage.

DREDGING in California now proceeds on recognized lines, the only changes in the dredges themselves relating to the more generous use of manganese steel and a steady increase in digging capacity. For instance, the No. 15 dredge of the Yuba Consolidated Gold Mines, California, has a steel hull 155 ft. long, 65 feet in the beam, and 12 feet deep. The buckets are 100 in number, each weighing 1500 pounds, and having a capacity of 17 cubic feet. They are held by 7½-inch pins. The upper tumbler is cast solid with the shaft, which is 18 inches in diameter. This dredge digs 80 feet below the water-level and removes a bank 20 feet high above, so that its digging height is 100 feet. The cost, we understand, was $400,000 and the machine will be at work in May next.

SILVER to the amount of 3,000,000 ounces was consumed by the Eastman Kodak Company during the year 1915. This suggests one of the items of consumption that helps the honest miner to get a price on his ore. The silver used by the camera is lost for good, that is, it is permanently diverted from the market. Moreover the growing cinematograph industry must consume several more million ounces of silver, so that when the miner on a holiday comes from camp to town he will be logical in patronizing the 'movie.' The one thing to be deprecated is the bestowal of iron crosses; as miners, we ought to insist on silver badges—the heavier the better—being used as the insignia of virile manhood.

OUR Melbourne correspondent sends one of his occasional but always interesting letters. He writes concerning the efforts made by the Commonwealth government to control the metal trade in the interest of the Australian people. While some of the steps may be prompted by hostile feeling against the present enemies of the British Empire, it is apparent that the underlying idea is to rid the mining industry of the tight hold of the German metal-merchants and to encourage the establishment of domestic manufacture. We have written several times in these columns concerning the non-national or international coterie that has a dangerous grasp of the metal business at London, New York, and Melbourne. Recognizing the danger of such control, we have taken pains to obtain metal quotations from an independent source. Anybody in charge of the sale of metals from our Western mines who does not avail himself of the protection afforded by the quotations published in this paper is unwise, to put it mildly.

AT the recent meeting of the San Francisco section of the American Institute of Mining Engineers the subject of flotation had been selected for discussion. Mr. E. H. Nutter, the local representative of Minerals Separation, Ltd., was invited to open the proceedings with an outline of the physico-chemical principles underlying the phenomena of flotation, but, for political reasons, he was unable to accept the invitation. Whereupon Mr. Edward C. Franklin, professor of organic chemistry in Stanford University, was invited to start the ball. He accepted, but, at the last moment, was prevented, by illness, from coming. Fortunately Mr. Robert C. Canby had come to the meeting as a guest, so he was persuaded by the chairman, Mr. G. H. Clevenger, to make the introductory remarks. Thus, by the irony of fate, one of the principal experts in behalf of the Miami Copper Company in the recent litigation took the place of the Minerals Separation representative. In consequence, we heard more about 793,808 than about 835,120.

and were more impressed by the efficacy of air than of agitation. It was a pity that both sides of the controversy were not adequately presented. We hope that Mr. Nutter may enlighten us when next we meet; or must we conclude that obfuscation rather than illumination is the desideratum of the gentlemen whose main office is at 62 London Wall?

Electrolytic Zinc

Mr. John D. Ryan, president of the Anaconda Copper Company, has confirmed recent rumors that a large electrolytic zinc plant is to be erected at Great Falls. On December 13 ground for the new works was broken, Mr. Ryan holding the plow and Mr. Ben B. Thayer driving the team while the first furrow was upturned, preparatory to clearing a site for the foundations. The new plant is to have a capacity of 70,000,000 pounds of spelter per annum and is to be completed by September next at a cost of $2,000,000. The decision to make this metallurgical departure is the sequel to a series of careful working-tests conducted under Mr. E. P. Mathewson's direction at the Washoe works. Of course, the choice of Great Falls as the site for the electrolytic plant is due to the fact that cheap electric power, of which 30,000 horse-power will be required, is available there, from the Missouri river. The experimental plant at Anaconda began operations in October, it has a capacity of 10 tons daily, but the actual output of zinc has been only three or four tons per day owing to the lack of an adequate concentrator for zinc ores. We understand that the refinery will be enlarged immediately to 25 tons capacity. Meanwhile another interesting step will be taken, namely, the building of a concentrator of 2000 tons daily capacity, using the Minerals Separation process of flotation, which will then supply zinc concentrate for both the zinc refinery at Anaconda and the one at Great Falls. As regards the treatment of the zinc concentrate, the process is a modification of the old sulphate roast as worked out by Mr. Frederick Laist and his assistant, Mr. F. F. Frick. The ore is first oxidized by a gentle roasting and is then leached with dilute sulphuric acid. Impurities in the solution are precipitated, the iron by means of limestone, the copper and cadmium by means of zinc. The main thing is to get a pure solution of zinc sulphate; this is then electrolized, using insoluble lead for anodes and either aluminum for cathodes or starting-sheets of zinc that have been deposited on aluminum sheets and then stripped. After the zinc has been removed from the electrolytic tanks it is melted in a small reverberatory furnace in lots of a few tons and ladled into bars of 50 pounds each.

Electrolytic zinc, being practically free from impurities, is extremely tough and particularly suited for the manufacture of the highest quality of brass, such as is used in munitions. In our issue of January 2, 1915, we published a description of another electrolytic method of zinc precipitation, as conducted at Palo Alto, California, by means of the Carl Hering patent, the idea of which is to employ an electrode able to combine with, and thereby remove, the impurities in the zinc sulphate solution. This is supplemented by the purification of the zinc sulphate solution by means of evaporation and crystallization. The plant at Palo Alto has treated small lots of baghouse fume from the Shasta county smelters and has produced some spelter of unexceptionable purity. However, the thickness of zinc precipitated has been so small as to interfere with practical success. Other experiments have been in progress in Shasta county, by the Bully Hill company, on lines similar to those of the process now successfully developed in Montana, save that the leaching is done with the acid electrolyte, so that the amount of sulphuric acid remains practically constant in the cycle of operations. Here also the experimental work has progressed to the point where the construction of a large plant is justifiable. We are informed that such a plant is to be erected within the next six months. This will lead to the resumption of smelting at Balaklala and Bully Hill. But the fact remains that the problem was solved first at Anaconda. This is an event of supreme metallurgical importance, for it marks the doom of the old retort furnace and the clumsy distillation methods hitherto in vogue in Europe and America. Combined with the successful concentration of the by-product zinc in copper, lead, and precious-metal ores by means of the flotation process, this radical change in the metallurgy of zinc will have far-reaching effects. The precipitation of the zinc from an ordinary complex ore yields a concentrated residue readily amenable to ordinary lead or copper smelting practice. Instead of the minor zinc content being the excuse for the exaction of a heavy penalty by the smelter, it will be a saleable by-product. This beneficiation of the zinc hitherto worse than valueless will cause a cheapening of the metal and a further extension of its use in the arts, especially in the galvanized iron industry.

Exit Villa!

On December 18 General Villa sent an announcement from his headquarters at Chihuahua that he had decided "to leave the Mexican field of war and temporarily retire to a foreign country." In short, he gave up the contest against the Carranza government and started to go into safe exile either in California or Cuba. Incidentally, the newspaper scribe who prepared Villa's valedictory was enabled to introduce some amusing hits at the expense of the First Chief of the Constitutionalist party, now President *de facto;* but for these sallies we have no space. The main point is that the military chiefs of the Villa *revoltosos* begged him to quit for his own sake and to make it easier for them to surrender to Carranza. Two days later it was reported from Washington that Villa would receive asylum as a political refugee in case he entered the United States. Obviously the State Department is only too pleased to see him eliminated from the Mexican tangle, for the event is bound to prove a big step toward the pacification of the country.

We hope that Villa will disappear. It would be pleasant to forget him. Just now we recall Kipling's maxim

that "the more we remember the less we forget." More Indian than Spanish, Doroteo Arango—to give his real name—was a murderer at 14 and a butcher's assistant soon after, becoming a brigand and a chief of bandits in the mountains of Chihuahua while still a mere youth. He is now 47. Early in his career he became known as Pancho Villa. During the Madero revolution he emerged from the mountains and developed into a successful soldier after the Mexican fashion. Thereupon his name became General Francisco Villa. A fearless man and a rigid disciplinarian, he rose under Carranza to the chief military command and retained it until mistrust caused a division, and then a feud, with his superior. An unlettered ruffian, he was wholly unfit for high political office, yet at one time it looked as if he were about to win President Wilson's support. Fortunately the logic of events prevented any such blunder. To have strained at Huerta and swallowed Villa would have been a historic miscomputation.

The popularity of Villa was due largely to his distribution of spoils among the lesser bandits. Property, when confiscated, was divided among his relatives and henchmen. The great haciendas in the North were parceled among his various friends. This free-handed scattering of the spoils of civil war was the secret of his domination. That and his courage. In his farewell statement he refers to his "financial situation" and asserts that he is taking with him "an amount of money equal to a Mexican general's salary for two year's service. Not one cent more." We do not doubt the accuracy of this statement, for we have an idea of what a Mexican general's salary ought to be in the Mexican general's own opinion. We presume that it is a good deal like a predatory promoter's notion of what "is coming to him." When marauding he knew no qualms. Rapine and murder camped in his tent; blackmail rode in front of his squadrons. To support his army he despoiled the countryside, driving cattle across the Rio Grande, shipping cotton from Tampico, and selling millions of bushels of the corn needed to keep the non-combatant population from starvation. By such means he obtained money; also by exacting ransom, and by printing paper money. This rampant brutishness was relieved by one good quality, physical courage, the first requisite of a soldier, but not so uncommon as to deserve special consideration.

No false sentiment should cloak the fact that Mexico had no chance of law and order so long as Villa was in command of an army. With his exit we see a good prospect of better days. At present, out of a total population of 15,000,000, barely 100,000 are under arms, while 200,000 are in some sort of sympathy with the belligerent parties. The refugees in exile number fully 600,000; and these, while not among the most virile element of Mexico, include many of the most intelligent. Out of the entire population we may set aside 12,000,000 Indians and 2,000,000 of either Spanish or mixed blood as non-combatants. Only a mere fraction of the Mexican people is now on the war-path; therefore the new government, backed by the United States, ought to be able to establish itself firmly at an early date. By aid of an embargo on the export of munitions from this country to any rebel forces and by help of financial patronage from Washington, it ought to be practicable for the Carranza administration to stamp out Zapata and the remaining political incendiaries. Already signs of returning confidence are apparent, mines are being re-opened here and there, and plans are being prepared for the active resumption of mining activity, especially in the North. There is $700,000,000 of American capital invested in Mexican mines and there are hundreds of professional careers linked to that great mineral region. We hope, and believe, that for the money and the men interested in peaceful industry in Mexico there is coming a renewal of opportunity.

Concerning A Clam

The business of a newspaper office is to collect and distribute information. This is especially the case in the office of a technical journal to which comes a constant stream of inquiries on all sorts of subjects, such as the probable demand for metallic molybdenum, the influence of lime on the selling price of baryta, or the best method of working a deposit of nickeliferous iron. Any information obtained by the editor is regarded as valuable in so far as it can be given to someone who needs it. A newspaper is the spendthrift of knowledge. It saves nothing and gives all. The practising engineer, on the other hand, regards knowledge from a different point of view. For him knowledge may be capital. The inquiry from the man who has molybdenum for sale leads the engineer to look for the buyer and to see if he cannot make a fee either by showing the molybdenite miner how to open his mine and how to concentrate the ore or to find capital for a profitable venture. Thus he seeks to be of service to seller, buyer, and the public at large. For if he who makes two blades of grass grow where only one grew before deserves praise, more is he of service who adds to the world's industrial activities and metallic resources another mine. A college professor occupies a middle ground between the practising mining engineer, who is always willing to exchange his knowledge for a fee, and the editor, who is anxious to give his knowledge away in exchange for a reading public. The professor is paid by his college not only for the instruction that he gives his pupils but also to work for truth and righteousness—sometimes within the limits set by the governing board. In this general search for knowledge a situation often arises when a word from the man who knows, be he editor, engineer, or professor, may have important practical consequences. For the editor, there is no problem if, for example, an inquirer asks his advice about spending $10,000 in a new process for extracting gold from a rock in which no gold is found by assay, but which is said, by a new application of radium combined with X-rays and the gyroscope to contain nascent metal. He will advise the gold-seeker to abandon the quest. The engineer would doubtless express his willingness to look

into the problem for a fee; and if no fee were in sight, he would also state plainly that the process was a fraud. As a rule, college professors are equally ready to give free information, but some sit with tightly-folded arms hugging their little bag of knowledge as if in deadly fear that it may escape through other than the normal channels of lectures or writings. Some indeed carry this feeling so far that one of them when asked by a recent graduate to criticize a proposed publication in the professor's specialty, refused, although he was aware that the ex-student's theories were false and likely to mislead the reader. Frankly, we cannot understand this professorial attitude. The editor feels it a duty to publish at once the denunciation of an error, so that his public may be benefitted, and it is a mystery to him why the professor should not be equally willing to work in the cause of truth. Fortunately such cases are rare—so rare as to be astonishing when found. We discuss the subject in order to prevent the one instance of which we are aware from becoming a precedent. Needless to say, it does not concern us or any personal friend. We discuss the matter in a spirit of detachment.

The Story of a Career

In this issue we publish an interview with that distinguished mining engineer, Mr. Hennen Jennings. For the length of this interview we offer no apology. Those who read it will realize that none is necessary. "The proper study of mankind is man." Nothing can exceed in human interest the story of an honorable career when told by an engineer to engineers. The contemporaries of the man interviewed will be keen to read what he has to say about his own doings and quick to appreciate his friendly mention of themselves. We find, on counting, that Mr. Jennings makes mention of 130 persons with whom he has been, at various times, brought in contact. Moreover, the younger men, to whom the subject of the interview is known only as an outstanding personality, will discover in the recital of his experience a wealth of suggestion and stimulus.

We find much on which friendly comment could be made. Mr. Jennings is one of hundreds to whom Shaler was a friend in trouble and a guide in success. Surely the gift of friendship that Shaler gave to so many young men during his long professorship at Harvard will continue to exercise its vibrant impression long after his lectures and poems are forgotten. But Shaler was only one of many notable personalities at the Cambridge of forty years ago. The magnetic touch of such men might well be felt for many years after the Harvard graduate had gone forth into the arena of life. Of course, New Almaden and El Callao afforded excellent training for the bigger work of Mr. Jennings in South Africa. The account of the introduction of the cyanide process on the Rand is particularly interesting. Evidently the discovery of zinc shaving as a precipitant for the gold was the first step in the practical success of the process. The next big event was the deep-level exploration of the banket seams, for which Mr. J. S. Curtis is given proper credit. He will be known best to Western miners as the author of the Eureka monograph. As will be seen, we ventured to put a delicate interrogatory in regard to the persistence of ore in depth and received a characteristically circumspect reply; yet, reading between the lines, it can be inferred safely that Mr. Jennings recognizes the inescapable reality, for, among other hints, he makes reference to the fact that even Methuselah found, as Voltaire said, that "*la vie, c'est une maladie mortelle.*" Perhaps Mr. Jennings had in mind an editorial that we wrote, in another place, 12 years ago, when the South African promoters, and engineers, were talking a little too exuberantly about sinking shafts to a depth of 8000 feet, to cut the Main Reef series at 18,000 feet on the dip. Well, 'Even Methuselah died' is not an unfitting epitaph on those irideseent dreams of unwearying persistence. The son of Enoch shows signs of 'handing in his checks.' However, let "the dead past bury its dead." Another and easier question to answer concerned the international components of the engineering fraternity on the Rand and the harmonious relations subsisting between them. We can understand readily that Mr. Jennings himself would ignore provincialisms of any kind, for we know how, in return, he won the personal regard of the English engineers, as is proved by his election twice to the presidency of the Institution of Mining and Metallurgy—perhaps the most signal honor out of many that he has won.

Indeed, it is a fine profession that can be typified by such a man as this. From a little town on the Ohio river to the capitals of Europe and America he followed his destiny, serving his apprenticeship in California, gathering basic experience in Venezuela, and applying a rare sagacity amid the delirious developments of the greatest goldfield in the world, the Witwatersrand, that 'white waters range' in the Transvaal where the biggest natural depository of precious metal in human history was uncovered by the mining engineer. Throughout the maze of circumstance we see the directing force of a strong character. Not quick to make decisions, not flashy in the expression of his mind, lacking the intuitions of nimbler brains, Mr. Jennings won respect and esteem for his poise, for soundness of judgment, and a rare balance of mind that proved of inestimable value to his famous clients at a time when they were developing the resources of a continent and engaging themselves in speculations of gigantic dimensions. If Alfred Beit was the piston, and Julius Wernher the fly-wheel of that notable partnership, it is clear that Hennen Jennings was the governor that regulated the safe motions of a great financial and industrial mechanism. For ourselves, we like best of all his own summary of his career and the discriminating appraisal of a fine achievement. To his friends, the last paragraph will seem characteristically modest; to the younger men it conveys the clear lesson that not much of enduring value can be done without the gift of co-operation, the ability to enlist the sympathetic help of others, the unselfishness to give them credit for such help, and that consistent capacity for taking pains that surmounts all obstacles.

DISCUSSION

Our readers are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment.

Safety in Mining

The Editor:

Sir—Referring to the article which appeared in your issue of August 7, 1915, on page 201, entitled 'Safety in Mining,' I beg to draw your attention to the quotation of an opinion which is attributed to me, in connection with the use of strap-irons as opposed to T-rails in incline-shafts. I do not remember ever having made the statement that "the best installation for a rope-hoist in an incline-shaft consisted of longitudinal stringers equipped with heavy strap-irons." The incline shafts of the East Rand Proprietary mines were equipped with 60-lb. rails, and not with strap-irons.

FRED HELLMANN.

Chuquicamata, Chile, October 17.

Mining Accidents

The Editor:

Sir—The letter published in your issue of December 4, entitled 'Mining Accidents,' contains a thought concerning Harry L. Day that is certainly not warranted by fact. It is true that at many properties work is carried on without proper consideration of the safety of employees. I have worked in some of these and have quit at times because of the danger. I have also worked as a laborer in Mr. Day's mine and know from personal experience that your correspondent's reference to him carries an unjust suggestion. I do not know Mr. Day, but am satisfied that if the care and well-being of employees had everywhere received the attention that has evidently been given it by him, the Safety First movement at mines would not have required the prominence that it has received lately.

PAUL M. PAINE.

Taft, California, December 7.

The Editor:

Sir—In reference to your article of November 13 regarding mine accidents and their causes. There is a statement by J. W. D. that 99 out of every 100 times the management is to blame. In regard to carrying powder, caps, and fuse up or down ladders, he asks have you ever tried it yourself. Yes. I have been mining for over thirty years, and I never saw or heard of a man killed from carrying powder, caps, and fuse up or down ladders. I would like to ask Mr. J. W. D. if he thinks it would be good management to have powder magazines on every floor in a stope that is many sets high and wide and endangering the lives of from 50 to 100 miners. J. W. D. said if the manager would go into the mines and work as a miner he would be able to prevent some of the accidents. As a rule the manager is not a good hammer-man but he is a good business man and he has his superintendent, foreman, and shift-bosses, and they as a rule are all practical miners. They are the men that are responsible for the miner. Over 60% of all accidents are due to the carelessness of the miner and not the mine manager.

P. J. DONNELLY.

Eureka, Utah, November 17.

[The discussion on this subject is now closed.—EDITOR.]

Moving Machinery

The Editor:

Sir—Responding to the letter of Mr. Storms in your issue of November 20, I offer the following note:

The local authorities own a pile-driving outfit consisting of a single-drum donkey-engine and a one-ton pile-driver hammer. When not in use on county work, this outfit is subject to loan to anyone in the county, with the understanding that the user has to get the outfit from where the last party left it.

We required the outfit to do some pile-driving. A bridge-contractor had left the equipment in a river-bed which was comparatively dry, but with a very soft bottom at the time we went for the outfit, taking with us several jack-screws, two sets of rope-blocks, some picks and shovels.

We picked up plenty of blocking near the site of the bridge, jacked the donkey-engine up high enough to run the wagon under it, then letting it down on the wagon-frame we found that it was necessary to build a temporary corduroy road to keep the loaded wagon from sinking in the soft river-bed.

This being too soft for the horses to do efficient work, we used one set of rope-falls, pulled by a team, to pull the loaded wagon up the bank and the second set of falls was secured to a stump and used to keep the donkey-engine from tipping over by hauling in the slack as the load was moved up the river-bank and onto the road, which has just been completed.

This road was too soft to suit the horses, so we used the rope-falls, secured to convenient stumps, to move the load along, keeping the horses on the solid ground alongside the new road. After going a short distance we found a place in the road that had been filled with old

trees and later burned, so we almost lost our load by upsetting. The second set of rope-falls was again used to keep the outfit on the wagon while it was jacked up and a small amount of corduroy road built under the wagon.

This concluded our mishaps. After going about one-quarter of a mile, we finally reached the old road where four horses handled the five-ton load with ease. By the time we reached our destination, a distance of two miles from the starting point, the work had required nine hours.

E. P. Dudley.

Kellogg, Idaho, November 23.

Flotation of Gold Ores

The Editor:

Sir—Mr. A. E. Drucker, well known for his work in cyanidation, in a letter appearing in your issue of November 20, made some very pertinent remarks in regard to flotation, more particularly concerning its application to gold and silver ores. His view is that of a metallurgist rather than of the man interested in the introduction of flotation. There is, as Mr. Drucker points out, a place in nearly every gold and silver mill for a flotation plant, and from the work that I have done so far, I have come to the same conclusion, namely, that flotation will be used in connection with water concentration, and that its best place in a gold and silver mill is in the treatment of the slime.

I think that in the future a common method for the treatment of gold and silver ore will be concentration by water and the treatment of the resulting sand by cyanide, with the use of flotation for the slime. A scheme like this could be adopted in many cases, thus obviating the necessity for fine grinding. The removal of the pyrite from the sand would allow quick treatment by cyanidation of the sand and the flotation of the slime, which would do away with the most expensive part of the cyanide plant, namely, the slime annex. However, the constantly recurring questions would be: what to do with the flotation concentrate? Considerable work is now being done in our laboratory to obtain a flotation concentrate low in insolubles. The average amount of insolubles is about 30%. I am now carrying out some tests to reduce these insolubles to a minimum, because if the concentrate is to be handled or shipped, it should contain the lowest possible percentage of insolubles. Flotation is now on the map and will be appearing constantly in the flow-sheets of the future.

Chas. Butters.

San Francisco, December 13.

Tuolumne

The Editor:

Sir—In your issue of December 11, in an editorial commenting on mining conditions in Tuolumne county, I notice an error which I wish you would correct.

You state that "the old Rawhide mine, near Jamestown, formerly owned by Capt. W. A. Nevills, is being unwatered and re-opened by the Pittsburg-Silver Peak company. The mine was examined and re-opened on the recommendation of Mr. Duncan MacVichie."

The Pittsburg-Silver Peak Gold Mining Co. at present has an option to purchase the Rawhide mine. We are now starting the work of unwatering. There has as yet been no examination made, and will not be until the water is out of the property. Mr. Duncan MacVichie had nothing whatever to do with the acquiring of this property by the Pittsburg company. Whatever examination has been made has been carried on exclusively by the staff of this company.

W. A. Bradley, General Manager.

Blair, Nevada, December 16.

Misuse of Technical Data

The Editor:

Sir—Recently my attention was called to a certain advertisement and an inquiry was made regarding it. The advertisement was not unlike other pamphlets of its kind, but as a whole more bold in general statements. It took advantage of some recently published notes on assaying as an argument in favor of certain so-called secret processes that the writers of the paper in question were fostering. Apparently the pamphlet was not meant for an engineer, rather for those who were confident that they had something in their ores but did not know what it was, or possibly would not believe the reports of reliable men. The material was without question a flagrant misuse of technical information: information that had an element of discussive features; it was something new and differed to a certain extent from other published papers on the same subject; for this reason, no doubt, it was singled out for their purpose.

I think that in the experience of every engineer such matters are brought to his attention at one time or another, and it is my opinion that they will second me when I say that the only remedy for an evil such as this is through the medium of the press. Unfortunately the technical papers that expose such matters reach those who already know the tricks practised.

The misuse of technical information is quite common, but unfortunately those misusing it are themselves technical men and therefore clever enough to employ it without casting suspicion upon themselves. The misuse of information pertaining to new metallurgical processes is the more common. I have noted several advertisements claiming that the extraction of a certain element can be made. Upon investigation it was found that in most instances a recently published set of notes on experiments or tests was being used as a basis: this in itself is not harmful; but when the published notes are for a certain ore and probably a refractory one, they can in but few instances be considered as applying to a class containing that particular element.

Frank A. Crampton.

Los Angeles, December 9.

Flotation—A Paradox

By DUDLEY H. NORRIS

Flotation is a paradox. In a flowing mixture of finely pulverized ore and water it causes the heavy metallic sulphides to float to the surface, where they are collected for further metallurgical treatment, while the light barren gangue sinks to the bottom and is run into the tailing-pond.

This apparent reversal of the attraction of gravitation is due to the introduction into the flowing mixture of a small quantity of oil or other emollient in such a manner that every particle of the ore, whether metallic, or gangue, is brought into contact with the oil, whereupon there is what seems a selective action between the oil and the metallic particles such that these become coated with the oil, whereas there is no such action of the oil upon the gangue. Under proper conditions, at or about the same time that this oil coating of the metallic particles takes place, there may be caused to appear in the flowing mixture bubbles of air. These attach themselves to the oil-coated metallic particles and stick to them with more or less tenacity, making a new entity consisting of metallic particle, oil-coating and air-bubble. The specific gravity of this entity is less than that of the water of the flowing mixture; thereupon, because of the attraction of gravitation, and not in spite of it, the heavy metallic sulphides float to the surface and the comparatively light gangue sinks to the bottom, neither oil nor bubbles having any tendency to attach themselves to the barren gangue.

My interest in flotation arose from the accumulation at my mine, the Magistral, at Zacatecas, Mexico, of a couple of hundred thousand tons of chalcopyrite ore of low grade which I had tried unsuccessfully to treat by water concentration. I came to San Francisco in February 1905 and went to London in June 1906, to investigate the two Elmore processes. I sent some of my ore to London and the tests showed a saving of 90% or more by the vacuum process. I set up an Elmore laboratory plant at the Magistral mine, 9000 ft. above sea-level, but got no satisfactory results—I judged that the altitude acted as a partial vacuum and that there was no air left in solution in the water. I then led a small pipe from the air-compressor and, tying a folded pocket-handkerchief over the end of the pipe, fed compressed air into the flowing mixture through 16 thicknesses of fine linen, 150 threads to the inch. I found that with a light pressure of air the bubbles coalesced on coming through the fabric and when released and started on their upward journey were of a uniform size, about that of a marrow-fat pea. With greater pressure the size of the bubbles was reduced, but the action of the air was so violent that the mixture was like a boiling geyser and everything, ore and gangue alike, was brought to the surface. Thereafter my flotation experiments were suspended until one day in a Pullman car on the Mexican Central railroad I drew some water into the hand wash-basin and I noticed that it was as white as milk, but presently became just ordinary transparent water. I saw at once that this was due to an artificial aeration of the water in the tank under the car, and when the train stopped, I read from the gauge that the pressure in the tank was 11 atmospheres. That seemed to be a solution of the problem of the lack of air in the water of the Elmore process; so I patented the method, together with the apparatus for utilizing the same.

It is not proposed here to discuss any theories of flotation, surface tension, ions or static or electric conditions or to explain phenomena, of which we at least know a little, in terms of something of which we know less. Instead of that, a classification is suggested, homely and commonplace in its terms, but which will impress upon anyone the exact limitations of each kind of flotation.

The oldest flotation is that including Everson, Froment, and others, and the Minerals Separation. It produces an "agitation to form a froth" and is exactly duplicated by the activity of the cook with a Dover egg-beater stirring what she is apt to call an "egg omelette."

Then there are the Australian processes known as the De Bavay and the Delprat, where an acid acts upon an alkaline carbonate and releases the carbonic acid gas, which action is duplicated in common life by the efficient Seidlitz powder.

Then there is the Elmore, which gets from ordinary water the air that the goldfish in the aquarium gets, and no more.

Then there are the Callow and the Towne processes, where air is forced through a porous medium, as above described; and, finally, the Norris process, which utilizes the air dissolved in water under pressure, as seen in the Pullman car or in the water-service at many places on the eastern shore of San Francisco Bay.

I believed that I had discovered a basic principle in flotation, and in September 1906 I applied for U. S. patents on the method and on the apparatus for using the Pullman bubbles in flotation; later I took out patents in ten foreign countries on the same basis. Continuing my metallurgical investigations in the summer of 1907, I went to nearly all the principal copper-concentrating mills in Colorado, Utah, and Arizona, and to Cananea. I saw all the stars of the first magnitude in the copper metallurgical firmament, but they shed no light on flotation. In fact, I was asked how the word was spelled. The net result was that I went back to Zacatecas and later built the Magistral smelter.*

*See 'The Copper Handbook,' 1912, page 545.

About this time I received word from my patent attorneys that I was opposed in the London patent-office by the Minerals Separation; but I instructed them not to appear and the case went on without me, as will be seen by the decision in the case where it is cited that "At the hearing Mr. Ballantyne appeared for the opponents; the applicant was not represented." Notwithstanding the fact that the opposition had things all their own way, the London patent-office over-ruled the opposition and decided in favor of issuing my patent, and when the Minerals Separation appealed to the law-officer the decision was affirmed, on February 24, 1910, and the British patent duly issued to me.

In the recent case of Minerals Separation against Miami, counsel for plaintiff said that the defendant interpreted the older patents, not in the light of the state of the art at the time the respective patent was applied for, but in the light of later developments. It so happens that a reference to the decision in Minerals Separation *v.* Norris, before the British patent authorities, shows that the Minerals Separation is now doing that very thing.

My British application was dated June 27, 1907, and was opposed by the Minerals Separation on the grounds of prior British patents, as follows:

No. 12,776	A.D. 1905—Froment
No. 29,283	1904—Elmore
No. 7,803	1905—Sulman
No. 26,712	1905—Sulman
No. 13,268	1907—Hoover

These include the British patents corresponding to some of the American patents on the basis of which the Minerals Separation sued Hyde and Miami in the United States courts, and the suits are now pending. The case in the British patent-office was decided, and the decision bears date, March 15, 1909. Consequently the position of the Minerals Separation as to the basis of their patent rights as stated in the case against me, between June 27, 1907, and March 15, 1909, is the true statement of their own idea of their rights and position and not that set up in the later cases some years after, and in the light of the more mature experience which is protested by Minerals Separation itself when used by the Miami company.

Here is the Minerals Separation position in the case against Norris, as appears in the decision, which says that Mr. Ballantyne relied mainly on the Sulman and Hoover patents. He contended that the underlying idea of the various processes is asserted in Claim No. 1 of the Sulman patent, that is, introducing by some means or other air under pressure into pulp containing oil and water and then allowing the pulp to come into a vessel which is open at the top to the atmosphere.

Claim No. 1 of the American Sulman patent "consists in mixing the powdered ore with water, adding a small proportion of an oily liquid having a preferential affinity for metalliferous matter (amounting to a fraction of 1% on the ore) agitating the mixture until the oil-coated mineral matter forms into a froth and separating the froth from the remainder by flotation." There is no hint in Mr. Ballantyne's presentation of his case before the London patent-office that he or his client, the Minerals Separation, placed any importance upon the little phrase in parenthesis (amounting to a fraction of 1% on the ore) and it can hardly be imagined that any court would permit, at this late day, a substitution of another idea for what Mr. Ballantyne claimed, in the case against Norris, to be the underlying idea of the various processes.

The decision, in my favor, contained these words: "It appears to me therefore, that the applicant is entitled to a patent for his invention****I decide therefore to seal a patent on the application***" The Minerals Separation appealed, but the decision was affirmed and the patent issued February 24, 1910. The Federal Circuit Court of Appeals, on appeal, decided the Hyde case against the Minerals Separation, in these words:

"We hold that to sustain the appellee's patent would be to give to the owners thereof a monopoly of that which others had discovered. What they claim to be the new and useful feature of their invention, as stated by their counsel, is agitating the mixture to cause the oily-coated mineral to form a froth. As we have seen, that feature was clearly anticipated by the prior art, and when the elements of the appellee's claims are read one by one, it will be found that each step in their process is fully described in more than one of the patents of the prior art, with the single exception of the reduced quantity of oil which they use."

The judgment of the court below was reversed by the Circuit Court of Appeals and a motion for a re-hearing was denied. Then the Minerals Separation applied to the U. S. Supreme Court for a writ of certiorari, which was granted, and the case is now before that court. The Minerals Separation advertised that the Supreme Court had granted their petition, without going into details as to just what the petition was. As a matter of fact, the granting of a writ of certiorari by the Supreme Court is in no sense a decision on the merits of the case.

Prior to 1891 an appeal to the Supreme Court from a Circuit Court was a matter of course, if the sum involved reached $1000, the result being a crowded calendar, years behind. In 1891 the Judiciary Act abolished the Circuit Courts, merging their functions in the District Courts, and creating the Circuit Courts of Appeals with final jurisdiction in many classes of cases, including patents. The Act provided for a writ of certiorari in cases where the judgment of the Circuit Court of Appeals is final and the rules of the Supreme Court say that the writ will issue where cases of great gravity or importance are involved or where two different Circuit Courts of Appeals have rendered conflicting decisions.

The proceedings on the application are very technical. A petition must be presented setting forth the facts of the case together with the reasons for the writ. Two weeks notice, or west of the Rocky Mountains, three weeks, to the adversary; and no petition will be granted within a fixed time before the end of the term. With the petition must be filed a certified copy of the papers

on which the court below acted and 30 copies uncertified. No oral argument is allowed. As Chief Justice Fuller expressed it: "The inquiry upon the application is whether the matter is of sufficient importance in itself and sufficiently open to controversy to justify the writ."

At the October term of 1914, at which the petition for the Minerals Separation writ was granted, there were 45 applications for writs of certiorari, of which 11 were granted and 34 denied. In the reports no reason is given for the Court's action in deciding petitions for certiorari; but it is extremely probable that a certain number of the applications were denied because the technical requirements of the rules were not observed. That is about the gist of the present state of the Hyde case. There has been no pardon nor commutation nor reversal, but merely a stay of execution.

The Minerals Separation also advertised that they had 36 patents on flotation, suggesting that their collection includes about all the flotation patents that have any real value. Unfortunately for this view, there is a letter in existence written by the Minerals Separation which says: "It is our custom to add flotation patents to our collection if they can be obtained reasonably whether they are of any immediate importance to us or not." That being their custom and the decision of the Circuit Court of Appeals being so strongly against them, the inference is irresistible that however little these waifs and strays of patents were bought for, they were not worth it.

One can understand the keen regret on the part of the Minerals Separation that their Froment process had not been patented in this country, but only in Italy and England. They started with the Cattermole process, which was not a success, and acquired the Froment afterward. The Cattermole, using 4 to 6% of oil, was an improvement on the Elmore, which used more. They acquired the Froment, which was a bubble process as against the processes using only oil, and then began a new series of American applications for patents. The attempts of the Minerals Separation to get a foothold in this country for their processes of flotation by "agitation to form a froth" begin with 835,120 Sulman *et al.*, dated November 6, 1906. This contained the agitation-to-form-a-froth idea but it is crudely worked out. Next came:

953,746. Hoover, April 5, 1910, with three beaters in an agitation-vessel; but this claims only one in patent for apparatus. Next came

955,012. Sulman, April 12, 1910, for process corresponding to Hoover's apparatus. Then

955,857. Hoover, December 27, 1910, claims mixing-vessel, an agitator therein, spitzkasten; also, a secondary mixing-vessel. Then

1,064,209. Hebbard, June 10, 1913. Claim 1. Apparatus for ore concentration by gas flotation, consisting of two adjacent mixing-vessels each containing a rotating agitator and a spitzkasten contignous. Claims 3, 4, and 5 cover a number of these elements.

1,067,485. Nutter *et al.*, July 15, 1913. Process for concentrating ores consisting of agitating water containing mineral-frothing agent, removing the froth, agitating pulp again with addition of another agent, producing another froth, "and so on."

1,084,196. Broadbridge *et al.*, January 13, 1914. Apparatus for agitation-frothing process comprising a series of agitating and aerating vessels and a series of spitzkastens.

1,101,506. Bradford, June 23, 1914. Introduces flowing mixture from mixer into a centrifugal pump, adding sulphuric acid and air and steam. Agitates to form a froth.

In all these patents the Minerals Separation is the assignee and the gradual advance is noticeable from the first claim of one vessel to the next claim for two mixing-vessels, then one agitation and another, "and so on." How far on is "so on"? Do they claim to use a third and a fourth vessel, and if so, must they use a different "mineral frothing agent" every time, or can they repeat with the same one? By the way, just what, in a strictly legal sense, is a "mineral frothing agent"? Does this cover any further discovery of such an agent that is thus preëmpted in advance? Is it anything and everything that will make a froth with a mineral?

Much of the phraseology of the Minerals Separation patents is vague and loose-jointed. If intentionally so, with the idea of making the most favorable interpretation in any circumstances that may be presented, the object is self-defeated, for it is an elementary principle of legal interpretation that words shall be strictly interpreted against the person using them.

This tendency is shown in Mr. Ballantyne's statement that Claim No. 1 of the Sulman patent is for the underlying idea of the various processes, introducing by some means or other air under pressure into pulp containing oil and water. "By some means or other," by any possible means, and Minerals Separation claims them all. "Agitation to form a froth" was their great claim, and in practice they seem to claim any agitation for any purpose whatever and any froth, however formed. So far has this been carried that it is said that Callow has desisted from the use of a paddle to keep his canvas clear from sand, although disclaiming any intent of forming a froth with it, because Minerals Separation takes the paddle to form a froth and proposes to keep it for all other purposes.

The present situation of flotation metallurgy is intolerable. There is every appearance that some time, perhaps years, may pass without a final judgment of all the Minerals Separation litigation and meanwhile they keep on collecting royalties from parts of the mining industry that are available for coercing the rest. Progress is halted. Development is retarded. Can nothing be done to rid the metallurgical Sinbad from this Old Man of the Sea? Statements are freely made that in case of a final Minerals Separation victory, a strict accountability will be required from all infringers.

The Norris process has given excellent results with the apparatus of both Minerals Separation and of Callow, the concentrate being of excellent grade from the rougher and from a slow stirring-apparatus after the Elmore

style of mixer. The process can be adapted to any type of tank, box, spitzkasten, or other receptacle and there is no danger of defeat from an attack on the Norris patents by the Minerals Separation. A method can be devised to float ores without using the Minerals Separation patents or paying them royalties. The day of royalties on daily tonnage is past. Arrangements can be made freeing the industry from this toll and also from extravagant prices for patented machinery.

The suggestion has recently been made that one of the most needed things in the mineral industry at the present time is some easy way of making flotation tests at the mine; so that a mill-foreman or mine-boss may be able to make his tests on his ores and decide whether or not they are susceptible to flotation and then design a process for treating them. Of course, any accomplishments that a foreman or mine-boss may have, add to his value; and ability to set a broken leg or cure a case of mountain fever might earn for him an additional salary, but aside from 'first aid' to the injured, no one would want to put himself in the hands of the foreman or the underground mine-boss for medical treatment. It is the same way with tests on flotation. Aside from mere preliminary experiments, testing ores for flotation is as much a separately professional matter as caring for a broken leg or a case of mountain fever. Metallurgical engineering is now so far advanced that there is but small reason for going astray in the matter of treatment of ores by flotation, provided adequate preliminary tests are made by expert metallurgical engineers. The cost of such tests is trifling and their importance and value not to be exaggerated.

One great reason why a mere practical millman or miner cannot devise a process from the patent claims and specifications is that most of the important elements of the actual installation are omitted from the patent. The essential principle of the patent of Elias Howe for the sewing machine was that the eye was in the point of the needle. Taking that for a starter, how far would a man get toward building a modern Singer from the Howe patent? It is like an equation in calculus. Take such an equation representing a mechanical movement and compare it with another equation of the path of a comet. Differentiate both and out go the constant factors and the differential equations might be identical in form. Re-integrate them. Do you get back your mechanical movement and your comet's orbit? You do not. Your constant factors do not re-appear. The same way with patent specifications and claims. They contain only the differentials. In fact, a recent letter from the Patent-Office said: "It is suggested that the claims eliminate all unnecessary references to structure and that they be limited to the actual process steps."

By a proper combination of interests, not only can there be avoided the payment of royalties on ores treated and high prices for patented machinery; and not only can every mill-owner be assured of the constant high efficiency of his plant, but he can be protected against infringing patents, and if sued for infringement he can be defended at a trifling cost to himself, a general fund being provided, at a small percentage of what the use of the Minerals Separation patent would cost him. The way to do is to perfect a process in a metallurgical laboratory to fit the special ore in each case. When the process is perfected care must be taken that it includes the patent principle under which it is to be licensed and does not infringe any other patent. In one mine in the Ninth Circuit where a home-made process has been patched up, it seems as though every well known flotation patent has been infringed, and yet the process will not work as it ought.

Well, suppose the program is carried out and the Norris process is generally adopted, and the Hyde and Miami suits are decided in favor of the Minerals Separation. That has no effect on the Norris process, not being a party to the present suits. A new suit would have to be brought against new defendants and another term of years passed before the Minerals Separation could hope to get any money, however favorable their case. But their case would not be favorable. The first thing that they would meet would be a certified copy of the proceedings in their own country where their own Government decided that the Norris process, although the applicant was not represented at the hearing, was not an infringement of the five patents governing the Froment, the Elmore, or the Minerals Separation processes respectively.

The Minerals Separation people were so sure of their strategic position, so confident that their American patents would be sustained by the courts that, from what seems mere wantonness, conditions were imposed upon the licensees that were intolerable; with the result of a concerted movement on the part of the whole mining industry to defeat the Minerals Separation patents and, from the present outlook, with every prospect of success.

Cost of Mining. J. R. Finlay said, during a lecture at the Columbia School of Mines: "Let us compare costs at a mine in southeast Missouri with one in Nevada, assuming that in both cases the output is at the rate of 4 tons per man per day. In Missouri, labor (at $2.60 per day) costs 65c. per ton of ore mined; power (coal selling at $2.25 per ton) costs 25c. per ton; supplies cost 15c. per ton; total cost, $1.05 per ton, leaving a profit of $1 per ton from which to deduct various general charges and interest. At a mine of the same character in Nevada, labor (at $4 per day) would cost $1; power (coal at $6.75) 75c.; supplies (20% higher than in Missouri) 18c.; total $1.93 per ton, or $0.88 higher than in Missouri. Assuming the same market-value for the ores, the profit would be respectively 12c. and $1. Hamilton Smith, a distinguished engineer thirty years ago, suggested the advantage of comparing mines on the basis of yield per unit of stoping-area. At Grass Valley, California, it costs about $5 to mine and mill a ton of ore; at the copper mines of Lake Superior it costs only $1.25, yet applying Smith's unit, the cost per acre of stoping-area is nearly alike in the two regions. The really important factor is not how many tons are mined, but how much area must be excavated."

Hennen Jennings, and Mining on a Big Scale

AN INTERVIEW. BY T. A. RICKARD

Mr. Jennings, you were born in the West?

No. I spent some ten years in California after leaving college, but I was born in 1854 at Hawesville, Kentucky, a small mining town on the Ohio river. At that time my father was the owner of a bituminous coal mine. He had come from New Orleans, where he was connected with large shipping interests.

Was the enterprise successful?

It was very tempting in that the coal outcropped along the river-bank and could be loaded by gravity-incline direct on barges in the river, but my father had no experience or training in coal mining, and the coal was found to be unsuitable for shipping South, as he had hoped. The river-steamboat market was limited, and although the mine was worked for a long time the venture proved unsuccessful.

What was your early education?

The Civil War interfered with my regular attendance at school, but my mother, a woman of rare culture, was my teacher and inspiration. Just after the war, when 13 years of age, I went with relatives to England, remaining there three or four years, part of the time at school in London and over two years at a small school in Derbyshire, at Farnah Hall, where I enjoyed a wholesome health-giving country life, and was stimulated in engineering matters by my teacher, Rev. E. E. Montford, who had love and attainment in mechanical and scientific subjects. Soon after my return to Kentucky my father died and I started to work.

What sort of work was it?

I erected a saw-mill on some timber property that had been owned by my father. I made a little money out of the lumber business and in such a way that it attracted the favorable attention of a relative who aided me in going to college.

You went to Harvard?

Yes, I graduated from the Lawrence Scientific School of the Science Department of Harvard in 1877.

That had not been long started?

The Lawrence Scientific School at Harvard is probably the oldest scientific school in the United States. It was started in 1847.

I suppose Shaler was the most interesting of your teachers?

Professor N. S. Shaler was under forty when I first met him, but his rare personality was felt by all the students who came in close touch with him. His course in geology was largely attended by the academic students as well as the scientific. His subsequent writings have shown him to rank high as a philosopher and poet, as well as a scientist. But above all, he showed himself a big-hearted human being to whom the students could turn for advice and comfort in time of trouble. One of his desires and aims was to bring the academic and scientific students in closer touch and to obtain for the future engineer a broader and more liberal education. The school was at a low ebb in point of members when I was connected with it, but some years later Shaler was appointed Dean and under his administration the scope of the work was enlarged, the social life of the students in the academic and scientific departments became more unified, and the attendance increased from 30 to over 500 students.

You were fortunate in coming under Shaler's influence?

Most decidedly. Shaler was the personality among my instructors that impressed me most. I had come to college unknown by him, but soon after my arrival he came to my room, having seen my name registered from Kentucky. He was a Kentuckian. He thought I might be lonely and came to give me a friendly welcome. He invited me to his house and I had the privilege of considering him a true friend as well as teacher until his death.

You took the course in Mining Engineering?

No. The mining course was not then well established. I took the course in Civil Engineering which gave all the preliminary training required for mining engineering, and I obtained the degree of Civil Engineer in 1877.

How did your education at Harvard fit you for your subsequent career?

The course then given has been greatly improved, but as it was it educated me in mental concentration and effort, and afforded me the foundation of the general principles in my profession.

You found plenty of mental stimulus?

Yes. I was thrown not only into contact with my own classmates, but I made friends of students in other departments of the University and also with some of the distinguished men among the teachers. At that time there were concentrated in Cambridge and its vicinity a number of men of great distinction. Charles William Eliot was then a young and active president; Oliver Wendell Holmes and James Russell Lowell were lecturers; Henry Adams, John Fiske, and William James were connected with the University in the Academic Department in their several specialties. In the Scientific Department, Benjamin and James M. Pierce and Henry Lawrence Eustis were professors of mathematics; Asa Gray was professor of Natural History; Walcott Gibbs and John Trowbridge were Professor and Instructor, respectively, of Physics; Josiah Cook, Professor of Chemistry; and Josiah D. Whitney, Professor of Eco-

nomic Geology. Longfellow was then living at Cambridge and Emerson at Concord. Naturally I absorbed some of the atmosphere created by these men.

When you left Harvard did you get a job at once?

Yes, I did, by the aid of my friend Hamilton Smith, who came from a little town in Indiana opposite my home on the Ohio river.

What was the nature of your first work?

Chiefly clerical, in connection with the re-construction and enlargement of a crib-dam by the North Bloomfield Co. in Nevada county, California. In the issuance of supplies and keeping of pay-rolls of the white men and Chinamen, I was much impressed with the accuracy of the Chinese head-men, who, with their abacus, kept accurate accounts and were thoroughly honest. This work in accountancy, coupled with what I obtained at North Bloomfield later, satisfies me that one of the most valuable experiences a young engineer can obtain is a good insight into the accounts and commercial considerations at the very outset of his career.

You were fortunate in winning Hamilton Smith's good-will?

Hamilton Smith, who was the consulting engineer, instructed me in the engineering problems of the work, and my connection with him was of great educational advantage, for he planned with daring and thoroughness. In the execution of his plans he stimulated effort in others, and in no way spared himself. Although largely self-educated, his scholarly book on hydraulics, published in 1886, showed that he was a master in the theoretical mathematics. His honesty of purpose won confidence and he was eminent among mining men both in this country and Europe.

Who else was connected with the North Bloomfield Co. at that time?

H. C. Perkins was the manager. He was a close friend and assistant of Hamilton Smith and had risen from the accountancy department of the company. His keen business sense was supplemented by his facility in mechanical details, as shown by his invention of a deflector for the hydraulic monitor. Our first meeting resulted in a life-long friendship.

Where did you go then?

I spent the summer at the English Dam and North Bloomfield. From there I went with letters of introduction from Hamilton Smith to J. B. Randol, of the New Almaden quicksilver mines. Up to this time I had been receiving a salary of $40 per month. It was now raised to $50. At Almaden I had the good fortune to become the assistant of a man who is one of the most character-building men it has ever been my privilege to know—Ross E. Browne. I re-surveyed with him the quicksilver mines, and made a topographic map. Mr. Browne left New Almaden to become instructor at the University of California, and I was then made chief surveyor. By reason of the training he had given me, I was able to come into engineering prominence through the close connecting surveys that I made in the mine under difficult conditions. This gave me my first step in the profession.

How long were you at New Almaden?

I was there in all about seven years, but with a break of two or three years. After making the survey I received an appointment as assistant to Mr. Perkins at North Bloomfield again, and I stayed with him about 18 months; after which he gave me charge of my first mine—the Ruby Gold gravel mine in Sierra county, the continuation of the Bald Mountain channel on the Forest Hill divide. At this mine we were disappointed in trying to intersect the channel, but afterward a deeper channel was cut by our tunnel, and in the finding of this, some reasonable hopefulness on my part gave me my first winning, because some of the owners abandoned the undertaking, permitting me to take some of their stock, which later proved profitable.

The mine was shut-down?

No, it was worked for several years after my departure and paid dividends under the foreman. I, however, was offered by Mr. Randol the position as superintendent of the New Almaden mine, and accepted. Randol had the reputation of being a hard taskmaster, but he proved an excellent friend to me and kept me up to the mark. The position afforded me an opportunity of working a complex lode and experience in working men on contract as well as day's pay.

Whom did you get to know at New Almaden?

While at New Almaden I first met Professor Christy, for whom I ever after retained a high regard. I came in touch with Fred Bradley, then a student from Berkeley, with Edward Benjamin, at that time model-making, and with Charles Butters, who acted as chemist for a short time while I was surveyor and engineer. George F. Becker made a geological examination of the district while I was there and I had the good fortune of again meeting him in South Africa, and the privilege of having him now as one of my Washington friends. I remained at New Almaden until 1887, when I went to Venezuela to take charge, as manager, of El Callao mine.

Were you not married in California?

Yes. I was married in 1886 to Miss Mary L. Coleman, daughter of John C. Coleman, one of the venturesome pioneers of 1850 who, with his brother, was successful in mining ventures. They were at one time chief owners of the Idaho mine at Grass Valley. Prior to this they were engaged in hydraulic mining at Iowa Hill. The soil on which was erected the house where my wife was born was later hydraulicked away, so there is a doubt whether the place of her birth is Placer county or the Bay of San Francisco.

Were you asked by Mr. Perkins to join him at El Callao?

Yes. He, and Hamilton Smith, who was acting consulting engineer of the El Callao Mining Co., arranged for me to succeed the former as manager. The mine had just passed its maximum activity; two years previous it

was the greatest gold mine in the world, yielding $200,-000 per month.

Can you give some further facts as to this celebrated mine?

The mine is situated on the Yuruari river, about 150 miles southwest of Ciudad Boliva, in Lat. 6° N. It is on the fringe of forest land near the savannas. It was owned by a Venezuelan eompany, but stock was largely. held in England, although the control was in Venezuela. It was opened up by a company of Corsiean traders, of whom one Liecioni was first president and chief owner. The existence of gold was known to the natives as far back as 1849 and attracted the attention of the Corsican owners soon after. At first it was supposed to be a gravel deposit, but in working to bedrock the vein was uneovered; there was a phenomenal amount of visible gold in white quartz, and for a length of two to three hundred feet a shoot of rich speeimen ore was found. The lode was finally exploited near the surfaee over a length of about 1000 ft. down to 900 ft. vertical. About $30,000,-000 was taken from the deposit. Work was started with small erushings in ordinary mortars and then a 10-stamp mill was erected, which was enlarged to 60 stamps before Mr. Perkins' arrival. The early erushings gave over $100 per ton, but eosts were from $30 to $40 per ton. Under Perkins' able management, and with ample funds at eommand, a new 60-stamp mill was constructed and the whole work thoroughly re-organized. The working eost was reduced to $13 per ton. At the time of my arrival the bonanza days were over and the orebody showed indieations of impoverishment.

Did the ore peter out?

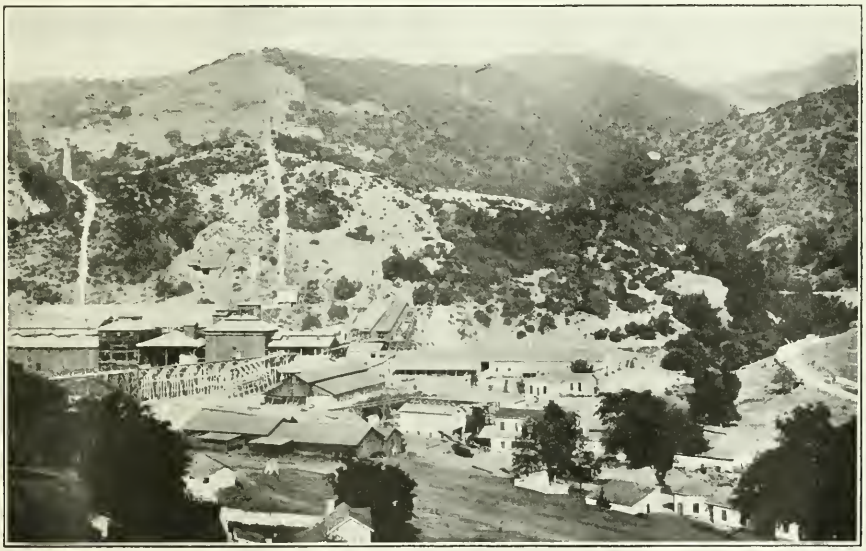
It did not peter out. Rather, it tapered out. The quartz continued, but it was not found profitable to work it.

Have you any explanation for the non-persistence of the rich ore?

The ore formation was an interesting and complex one, but difficult to deseribe briefly without diagrams, and I have no eonvincing explanation to advance as to the non-persistenee of the rieh ore.

El Callao served as a practical school of mining for a number of men, I believe. What others besides yourself?

Hamilton Smith made the first elaborate report on the property for the Rothschilds and eame in sueh elose touch with the local owners in Venezuela that he was made eonsulting engineer and brought about the Perkins management. Mr. Perkins had among his assistants Thomas Mein, who was his first mine-eaptain at El Callao, becoming later manager of the Naeupai, an adjoining mine. Captain Mein was afterward superintendent of the Alaska Treadwell mine; and then, in 1892, of the Robinson mine in South Afriea, where he was much respeeted and beloved. Louis Seymour was at Callao in connection with the machinery of the 60-stamp mill and became one of Mr. Perkins' mechaniea assistants. He was afterward mechaniea engineer at De Beers, South Afriea, then manager of Fraser & Chalmers' works at Erith, England, and again chief mechaniea engineer of H. Eekstein & Company at Johannesburg. He was the organizer of the Pioneer Engineering Corps, which repaired bridges and other construetion destroyed in the Boer War, and lost his life gallantly at Sand River.



THE FURNACES AT NEW ALMADEN IN 1886.

Who else was there, Mr. Jennings?

George Webber succeeded me as manager in 1889 and reduced operating costs to $10 per ton before his departure. He was afterward manager of the Crown Reef and then the Rand Mines in South Africa, and he, in turn, was succeeded by Barry Searls, who became manager of the Crown Deep Mines, South Africa. M. Robeson acted for a time as mechanical engineer for the Nacupai and was also my mechanical engineer at El Callao. Subsequently he became assistant to Seymour at De Beers and, at Seymour's death succeeded him as Chief Mechanical Engineer to the Ecksteins. E. A. Blanton invented the cam now so well-known in stamp-milling while at the Union mine, El Callao. Subsequently he became Mechanical Engineer at the Crown Reef mine. Robert Duncan, my foreman, became manager of the Alaska Treadwell mine. Richard Bowen became chief millwright to the Rand Mines. John Walsh, the mill-foreman, was later mill-manager at the Ferreira mine. J. Klimke, later State Mining Engineer of the Transvaal, was a surveyor in the Callao district at the time of my arrival. I became acquainted with F. H. P. Creswell, of the Chile mine, who afterward became manager of the Village Main Reef and has attained prominence in political strife in South Africa.

I suppose El Callao furnished as good experience in gold mining as could be obtained at that time?

Yes. The distance of Callao from sources of supply and the honest and progressive work there accomplished by men thrown so very much on their own resources, coupled with the command of large funds to install the best appliances, afforded a fine training.

What was the metallurgical process?

Simple amalgamation in stamp-mills. It did not pay us to ship concentrate. It was the simplest ore I have ever seen, some forty or fifty bags of specimen ore per month adding largely to the output. We used blankets and canvas tables for making a rough concentrate. Some of this was subjected to calcination or re-ground in pans or barrels with quicksilver.

How long did you remain at El Callao?

Two years. I had a two-year contract.

Your health was good all the time?

I was taken with fever two days after my arrival, but I had it in mild form. The doctor said, "You have the right fever and will never have the serious trouble that may come to people who have not been thus inoculated." My family, however, did not thrive, so they returned to New England pending my arrival. It's the everlasting heat that saps the energy of men in the tropics: the thermometer seldom went over 90°, but never below 70°. The humidity was excessive. The clearing of forest-lands and the system of housing and living at El Callao made it comparatively safe for white men. Most of those who were there during my time are still alive.

From El Callao you went to South Africa?

I first went to London, where I obtained an appointment with Jules Porges & Co., the predecessors of Wernher, Beit & Co. and the parent firm of H. Eckstein & Co. in South Africa. That was in 1889. I arrived on the Rand in December of that year.

What stage of development had the Rand reached at that time?

The first gold from the Witwatersrand conglomerate was panned in 1885. Johannesburg was founded in 1886. The first stamp-mill erected working on the 'banket' was the Wemmer in 1887. At the time of my arrival the monthly output from the mines had reached 39,000 ounces and the total return for that year was £1,300,000. The mining laws of the Transvaal were liberal and definite. Feverish pegging of claims had taken place in all likely localities. Boom hopes and market quotations had soared high, but were on the wane; market depression had set in and continued for some three or four years, during which time much good constructive work was done. Not many mines showed a substantial net profit, in spite of high yields. No railway had then reached Johannesburg and the cost of working was extremely high, while extractions in the mill were painfully low. The workings were just entering the pyritic zone, for example, in the Percy and Jumpers mines. Everybody was anxious about the continuation of the deposit and was questioning the proper method of treating the pyritic ore.

At what depth was this pyritic ore intersected?

At between 50 and 250 ft. down. The average gold recovered at that time was not over 60%, but the tests that had been made showed that the extraction by amalgamation was just about as good on the pyritic as on the oxidized ore.

What was there to supplement plate-amalgamation in the mills?

Only blankets. There was no systematic treatment of the concentrate. It was stored for future treatment. Several processes were being discussed, for instance, the Vautin, which was chlorination under pressure. The chief producing mines then were the Robinson, Crown Reef, Langlaagte Estate, Jumpers, Durban Roodeport.

How much were these mines producing?

There were about 40 mines with stamp-mills at work, averaging about 20 stamps per mine. The Robinson was the richest mine, with 40 stamps treating about 4000 tons per month, a yield of about £28,000 or £7 per ton. The Crown Reef, with 70 stamps, treated about 4800 tons, yielding only 33 shillings per ton. The Langlaagte Estate, with 70 stamps, was crushing about 6000 tons for a yield of 70s. per ton. The average yield for all the mines for December was 3900 oz. at 63 shillings or $15 per ton.

What was your position?

I was engaged as consulting engineer to H. Eckstein.

Can you give some facts about this firm and your connection with it?

The firm of H. Eckstein was a branch in Johannes-

burg of Jules Porges. Julius Wernher was connected with Porges in diamond-mining at Kimberley as early as 1876. In 1884 they formed a close connection with Alfred Beit—a most fortunate combination. The latter became the Kimberley representative of the firm, while Wernher went to London. Beit had great intuition and imagination, while Wernher had great sagacity and prudence. Beit was the valve-gear and Wernher the fly-wheel of the firm of Wernher-Beit, which took over the business of Jules Porges & Co. soon after my arrival in South Africa. Hermann Eckstein came to Kimberley before Beit was associated with Porges.

And Beit became the coadjutor of Rhodes?

Yes. Beit was a great believer in and friend of Cecil Rhodes, and without his aid it is doubtful if Rhodes could have accomplished the amalgamation of the diamond mines. At Kimberley these men were also thrown into contact with J. B. Taylor, Lionel Phillips, and George Rouliot, all of whom became members of the Eckstein firm and had dealings with J. B. Robinson. They became acquainted with American engineers in the sterling personalities of Gardner Williams and Louis Seymour. They were also all friends of Dr. Jameson and each other, for early experiences knit people together. Financed by the Porges firm, H. Eckstein and J. B. Taylor opened an office at Johannesburg in 1887 under the name of H. Eckstein, the title being changed to 'H. Eckstein & Co.' after the death of Hermann Eckstein in 1893. Friedrich Eckstein joined them in 1888 and Lionel Phillips in 1889. George Rouliot, Percy Fitzpatrick, Raymond Schumacher, and others were given interests at considerably later dates. I received a cordial welcome from Taylor and Phillips, and a few months later a hearty one from the Ecksteins.

These must have been able men?

Indeed they were. Hermann Eckstein was made the first president of the Chamber of Mines in 1890. Besides being a keen man of business, he was most generous and kind-hearted. The Ecksteins were sons of a Lutheran clergyman and were born at Stuttgart, South Germany. Hermann Eckstein's death in 1893 was a great loss to the Rand. Subsequently, Friedrich Eckstein took a prominent part in the business. He is fortunately still alive and has much of his brother's ability and kindliness. Both Taylor and Phillips have won distinction and remain close and loyal friends.

MINING ON THE OUTCROP OF THE BANKET AT THE FERREIRA MINE IN 1888.

How did the firm of Wernher, Beit & Co. acquire its big control?

In 1886 Beit financed J. B. Robinson in his purchases of farms on the Rand and in return the firm received large holdings in the Robinson, Langlaagte, and Randfontein properties, but they so traded that their holdings in the Robinson mine became their dominant one. Besides interests in the above mines at the time of my arrival they controlled the management of the Ferreira mine, then in the equipment stage, and had large holdings in the Crown Reef, Jumpers, and Bantjes, and considerable 'deep-level' ground. They made big profits in the boom 1888-1889, but as they believed in the future of the goldfield, they were desirous of giving the mines they were connected with every advantage that science and money could furnish. They endeavored to place the high capitalization due to the boom on a solid basis of actual returns. They took all risks in initial stages and floated no companies that had not intrinsic promise. They asked no reports from their technical staff for flotation or stock-market purposes. They encouraged the collection of statistical information, which was given freely to the public to an extent not elsewhere known in the mining world. The returns from the mines were given under oath. They trusted fully and rewarded liberally those that won their confidence and approval. I consider it a rare good fortune to have been thrown with these men as I was, and to recall my pleasant and cordial relations with the original members of this firm, which continued for 16 years without rupture except by death. The untimely deaths of Hermann Eckstein in 1893, Beit in 1906, and Wernher in 1912, robbed me not only of honorable, powerful, interesting business associates, but also of kindly loyal friends.

The initial success at the Robinson and the Ferreira encouraged them to obtain controlling interests at low prices in languishing mines or those on which work had been suspended, such as the Crown Reef, New Heriot, City & Suburban, Village Main Reef, Salisbury, Henry Nourse, New Modderfontein, Nigel, besides deep-level companies, etc., for all of which I acted as consulting engineer, as well as for the Robinson. By liberal financing and good management these were placed on a most prosperous basis.

The fruit of their policies is seen from the returns of the Eckstein group of mines in 1911 prior to the death of Sir Julius Wernher. The output of the Rand for that year was approximately £34,000,000 from about 24,000,000 tons crushed, of which over £12,000,000 was produced by the Eckstein group crushing nearly 9,000,000 tons. The men employed during this year numbered about 25,000 white and 190,000 natives, or more than is employed in all the gold, silver, copper, lead, and zinc mines in this country. The Eckstein group worked about 8000 white and 56,000 natives, and earned over 40% of the dividends declared.

What were your first impressions of the Rand?

I went to the Rand with little knowledge of the work already done and with no preconceived ideas as to how it should be done. My brother came out with me, but he went to the Willows silver mine near Pretoria, then to Kimberley, and did not enter gold mining until 1893. I brought with me no assistants, but soon obtained the efficient aid of Arthur Wilkinson, the secretary of Eckstein, also of Fernside Irvine, a Scotch mechanical engineer, John A. Dennison, a young Englishman, also Hugh F. Marriott, a graduate of the Royal School of Mines, who did excellent work in connection with the early bore-holes. I realized at once that the Rand presented different conditions than any that had theretofore occurred in my experience or reading, and I was frank enough to beg for time to educate myself on the spot. I did not attempt a comprehensive report of my views until March 1890. The report was conservative. It gave warning as to boom values, but showed confidence in the future of the goldfield; it advised that profits should be moderately estimated and carefully striven for. Time was taken to educate myself and then my principals that it was right and necessary to spend largely in order to reap bountifully, but this was soon fearlessly done on a great scale.

What metallurgical advice did you give?

At that time nobody realized the great downward continuation of the ore, nor did we know how best to extract the gold. I knew, and others knew, that by increasing the number of Frue vanners such as were used in the Robinson mill, and by using more blankets, we could increase the extraction. This was done, and it was also decided to treat the concentrate by chlorination.

Was that when Charles Butters was engaged?

Yes. I had known Butters in California, and he was also known to the other Californians, so a telegram was sent to Perkins, who offered him an engagement.

When Mr. Butters arrived you proceeded to erect a chlorination plant at the Robinson, I presume?

Yes, and that plant eventually proved successful. Before its construction James S. MacArthur, J. H. Cordner-James, and Alfred James came to the Rand and gave us an opportunity to test the now famous MacArthur-Forrest process of cyanidation. Alfred James took a leading part. The first test-plant was erected at the Salisbury mine in 1890. As a representative of the Ecksteins, I was given the first opportunity to ascertain the efficiency of the process.

What plant did they have?

They agitated with paddles in tanks, but on a small scale. The plant gave no opportunity of determining the cost of working on a large scale, but it did afford facilities for determining the extraction. I watched the work with my assistant, from the charging of the tanks to the final clean-up and was much impressed with the result.

That was an historic occasion, Mr. Jennings?

Yes, indeed. I had the opportunity of being thrown into intimate contact with MacArthur and Alfred James. MacArthur was a most modest man, and impressed me with his quiet ability. The only claim he made for his

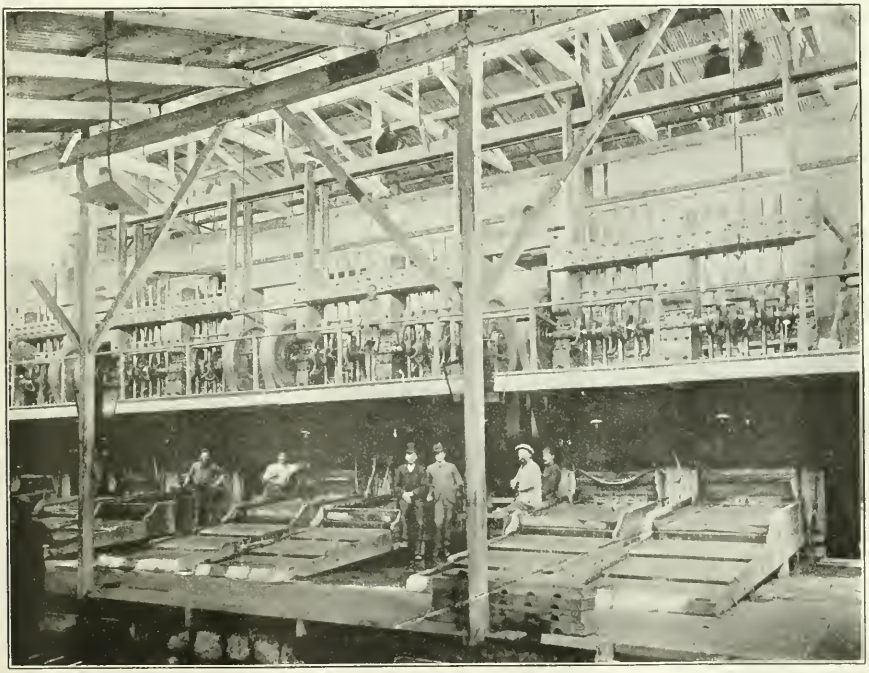
part in the discovery of the process was that he had suggested the means of precipitating the gold. The idea had occurred to him through seeing workmen making shavings from a big plate of zinc. He conceived the idea of using zinc shavings in a compact form instead of precipitating on a big plate area. Thus he made the process practicable. Of course, the theoretical knowledge of the solution of gold by cyanide and the precipitation of the gold on zinc was a matter of encyclopedic record. MacArthur's adoption of the use of dilute solutions was the key to the usefulness of the process.

What did the people on the Rand think of it?

The fact that the cost was not given prevented the ward given the right to work the process itself at a minimum royalty. This was duly arranged.

Who built the first cyanide plant?

The first cyanide plant on the Robinson mine was designed by Alfred James and MacArthur, and in that plant all the fundamental principles now to be seen in modern practice were in evidence. Of course, subsequent work has immensely improved the details and lowered the cost. This plant was placed in charge of G. A. Darling, one of the men brought out by MacArthur. That was in 1891 and 1892, after which the Robinson company took over the plant and started a larger reduction works, the designing of which was



INTERIOR OF THE ROBINSON 40-STAMP MILL IN 1889, SHOWING BLANKETS USED FOR ROUGH CONCENTRATION, THE SAND RUNNING TO WASTE. TOTAL RECOVERY ONLY 66%. YIELD, 7 OZ. GOLD PER TON.

companies on the Rand from taking it up at once. I found out afterward that the extractions obtained in the initial test were confirmed by practice on a large scale. At that time MacArthur was aware of the need of fine grinding in the obtaining of high extractions. The cost of these early experiments must have been over 30 shillings per ton, so that it was no wonder the owners of the patents were desirous of keeping them secret, and it was this high cost that caused MacArthur and his friends to discard agitation.

Did your firm make any arrangements with them?

Yes. Eckstein & Co. expressed willingness to have the accumulation of tailing treated on a sliding scale by the owners of the process, provided the firm was aftergiven to Charles Butters, who had shown such skill and energy in connection with the erection of the chlorination plant. Mr. Butters was limited in the size of his tanks to the maximum then known to be successful in operation, namely, a diameter of 23 ft. He introduced the bottom discharge.

What was the position of Alfred James in this business?

He was the brother of Cordner-James, who had the patent rights in South Africa with Webster. Alfred James was associated with the Cassel company—as was MacArthur—and he was a great factor in the designing and starting of the Robinson plant, which may be said to have been the first large cyanide plant erected on the Rand.

This first plant then was for the treatment of accumulated tailing from the ore mined in the oxidized zone. Did not the oxidation interfere with the cyanidation?

Certainly it did. The acid had to be neutralized with lime. In the extraction given by MacArthur it was shown that pyritic concentrate as well as tailing could be treated successfully, and one of the first plants to do this was that at the Nigel mine.

Who was the metallurgist or manager of the Nigel?

Richard Gluyas was the manager, but the plant was erected and for a time run under the direction of my assistant, Fernside Irvine.

What about the direct filling of the tailing into the cyanide tanks?

The first attempt, which was under my guidance, to accomplish the continuous treatment of the product from the stamp-mill was made in 1893 at the Salisbury mine, where square wooden tanks were used in connection with an hydraulic classifier that separated the slime from sand. The practical success of the method was only demonstrated later at the New Heriot and Nigel plants with round tanks under the control of W. K. Betty and Fernside Irvine. J. Harry Johns, of the Ferreira, a Cornishman, and graduate of the Royal School of Mines, was a co-worker and friend, and lent me aid in this and other work during my stay in South Africa. The method was finally adopted at all the mines, an improvement over the original hose-filling of the tanks being made by the Mein-Butters distributer.

Did you use concrete or cement vats?

The first tanks of great diameter—40-ft.—were constructed at the Langlaagte Estate under the direction of George Richards, manager, and John R. Williams, metallurgist. The latter afterward had charge of the square concrete cyanide-tank plant at the Crown Reef and made the first successful treatment of slime by the decantation process there. He was also for some years directing metallurgist for the Eckstein group of mines. Square concrete cyanide tanks were also erected at the City & Suburban mine.

What other metallurgists can you mention?

In the metallurgical department of our firm were two other men who came out with Alfred James and MacArthur, namely, W. K. Betty and S. H. Pearce. They were prominent in the subsequent development of the cyanide process, Betty introducing an effective method of increasing or stimulating the extraction in the zinc-boxes. Fernside Irvine, my assistant in the firm's mechanical department, became also most proficient in cyanide construction work. Alfred L. Simon was another able chemist employed by us who experimented with the Malloy sodium-amalgam process. William Bettel came out for the Willows Silver company and worked for some years at the Robinson. W. W. Mein took charge of the chlorination work shortly after Butters left the Robinson employ. Some other well known chemists on the Rand, but not with my firm, during my stay there, were Andrew F. Crosse, W. R. Feldtmann, A. von Gernet, and H. F. Julian.

My understanding, Mr. Jennings, is that you were one of the first to introduce electric power on the Rand?

No, I do not think it quite accurate to say "first," but the new plant which I designed at the Crown Reef mine used electrical appliances more extensively than any other mine at that time on the Rand. Besides large underground and surface return-water pumps, the tramming from the mine to the mill was electrically done, and small motors were used in various ways. In this work I had the enthusiastic co-operation and assistance of Herbert Davis, the electrician, and the loyal energy and hearty co-operation of the general manager, George E. Webber, who had followed me to South Africa from El Callao, and who afterward became general manager of the Rand Mines.

Mr. Jennings, I would like to ask you about the deeper development of the Rand. When did you realize that the Main Reef series would persist to a great depth?

The persistent optimist in regard to the continuance of the ore in depth was Alfred Beit.

But surely Beit's optimism was founded on the advice of some engineer?

Yes. The first exponent of this belief was J. S. Curtis, at the Village Main Reef, where, in 1890, the depth of the banket was proved by a bore-hole to 530 ft. The piece of the banket pierced is now on view at the Exposition. The Rand Victoria bore-hole was sunk in 1893 and proved the continuity of the ore to a depth of 2300 ft. The Bezuidenville hole intersected the South Reef in 1895 at a depth of 3100 ft., the Turf Club hole in 1901 intersected it at 4800 ft. In this diamond-drilling I received valuable assistance from Hugh F. Marriott. In the deep bore-hole at the Turf Club hole we used his ingenious device for indicating the diversion of the bore from the straight line and were astonished at the extent of the deviation. All this drilling proved unmistakably that the southern strata of the Main Reef system are continuous wherever observed, and with them the gold-bearing banket. It showed also the tendency of the lode to flatten, and made it possible to lay out plans for future workings.

In other words, you were able to foresee the change of dip on the evidences of a synclinal structure?

This was known to me and to many other engineers, but it was first estimated closely by Hamilton Smith during his visit in 1892. The estimate that he then made of the value of gold in the banket to a depth of 3000 ft., and for only the richest section of 11 miles, was £350,000,000. This, considering all the circumstances, was a bold and far-sighted prediction, although under the mark, as the goldfield from 1887 to June 1915 produced £435,000,000. He wrote an article on this subject for the *Times* and that, no doubt, did a great deal to establish public confidence.

When it became apparent that the lode would persist, your firm formed a consolidation called 'The Rand Mines,' did it not?

The Rand Mines as a corporation was not formed until 1892. Interest in considerable deep ground on the dip from the richest mines had been secured by my firm prior to my arrival. At that time the public had lost faith in deep-level schemes and some were abandoned. After my arrival large areas farther on the dip were either purchased at low prices, pegged out, or acquired by amalgamation. In this way some 1700 claims, or about 2000 acres of ground, was obtained that commanded the dip in the choicest districts of the Rand, and at moderate depths. The capitalization of £400,000 represented only the cost-price of the ground, without equipment. Prior to the arrival of Mr. Perkins in 1893 I acted as consulting engineer and laid out some of the I have mentioned were developed and equipped on a scale demanding an outlay of six or seven million sterling, working 1300 stamps and crushing nearly 2,500,000 tons per annum, yielding over £4,000,000 per annum.

Now, Mr. Jennings, I am going to ask you a delicate question. Do you believe that the ore, that is to say, the banket containing enough gold to be profitably exploited, will persist to a uniform depth on the Rand of, say, 5000 ft.? Do you not conclude that the evidence already available indicates that the Main Reef series is becoming poorer in depth?

That, of course, is a most difficult as well as delicate question, especially as I have not been on the Rand for more than 12 years. Statistics plainly show the falling off in yield from the early to the later years, the average dropping from 42 shillings per ton in 1890 to 27 shillings

SLIME AND CYANIDE PLANT OF THE GELDENHUIS DEEP.

first shaft-work. Mr. Perkins was given full control, and under his administration, lasting some three or four years, nine subsidiary companies were either started, developed, or partly equipped, namely, the Glen, Rose, Geldenhuis, Jumpers, Nourse, Ferreira, Crown, Langlaagte, and Durban Roodeport 'deeps.' Under his direction the first great advance in the speed of shaft-sinking was made, but was afterward exceeded by the Gold Fields group when more than 200 ft. per month was sunk in some of their large shafts. His construction work was done with despatch and economy, but he left the Rand after the Raid and saw only the Geldenhuis Deep started.

But, if I remember correctly, the Geldenhuis Deep was something of a frost?

I suppose it was. Considerable disappointment was first experienced in the Geldenhuis Deep, due to difficulties in cyanide work, and also in the yield, but in the end, through Mr. Webber's efforts and more extended development work, the mine was brought to a successful issue, as is shown by the records. In the end the mines in 1914. This certainly puts up danger signals, and while there is no doubt that the ore very near the surface was richer than that at any considerable depth, yet selective mining was rightly and naturally done in opening out properties under adverse economical conditions. The reduction of working costs justifies the working of more and more low-grade ore, so it becomes a difficult proposition to know whether the falling off is due to impoverishment in depth or to less selective mining of the ore, or to both. The greater the number of stamps erected, the more temptation there is to work some unprofitable low-grade ore to keep them going.

From the deepest shafts and bore-holes it is evident that there is some profitable ore at a depth below 5000 ft. and before the exhaustion of the goldfield it is probable that the average working cost will be very materially reduced, and thus will allow even leaner ore to be worked. The water in the deepest workings does not present a serious problem; pumping and winding machinery has been so perfected that in this department low cost even at great depth can be looked for. But,

even as Methusaleh died, so also must the Rand, and if it survives a decreasing yield, then increasing temperatures and numbers of stamps must drive out workmen and wear down the present deposit so that in twenty or thirty years there will be little left to exploit at large profit.

Can you tell me anything about the starting of technical societies on the Rand?

The first technical society on the Rand was the South African Association of Engineers and Architects, formed in 1892, of which I had the honor of being first president; S. J. Farrar and A. H. Reed, were Vice-Presidents, E. P. Rathbone, Treasurer and Secretary, J. S. Curtis, T. Reunert, C. Aburrow, and G. R. Andrews, Members of Council. It was started in a modest way, but finally developed into an important society and the title changed in the year 1898 to South African Association of Engineers, as less than 10% were architects. Under its auspices Behr's paper on 'Winding from Great Depths' was brought out and discussed in such an intensive way that it finally resulted in a special volume in the proceedings of the Institution of Mining and Metallurgy in London.

In addition to this society there was formed in 1894 the Chemical and Metallurgical Society of South Africa, of which the early presidents were William Bettel, Andrew F. Crosse, W. R. Feldtmann, John R. Williams, and Charles Butters. This society was very much of a live wire and had much to do with the development of the cyanide process, as in its proceedings many papers on the various details of this process were presented and most energetically and candidly discussed.

I believe these societies have been very instrumental in stimulating and extending the usefulness and advancement of technology. Their early meetings were animated, they brought the technical men of the Rand in closer touch, and made their work and characters known to each other and to the world.

What were the first steps taken in technical education in South Africa?

Nothing was done under the Boer rule in the Transvaal in this connection, but a good start was made in 1896 in a divided course at Cape Town and Kimberley. The War interfered with this work and after the War the school was consolidated with one started at Johannesburg about 1904. The one at Johannesburg had its rise in the interest Lord Milner took in technical educational matters in the Transvaal and the formation by him of committees and commissions to look into the feasibility of starting such institutions. The first committee, of which I was a member, was formed in 1902. I was also associated with Professor Henry Miers—now Sir Henry Miers of London University—in an advisory capacity. Night-schools were started and work done on a small scale. Prof. James G. Lawn of the Kimberley School initiated some of the earlier work. Prof. Hele Shaw, of the University of Liverpool, was sent out in 1904 or 1905. The school gradually expanded in temporary quarters, but the grants of a building-site by the Government permitted the erection in 1909 on Plein Square of an imposing building costing $300,000, equipped with all up-to-date laboratory appliances. In this building is housed the Seymour Memorial Library, with an endowment of $50,000. A hall of residence, Sunnyside, is provided for the Dean and students in the suburbs, and it is interesting to me to remember that besides serving as a residence of the High Commissioners, it was before its enlargement, my home. This institution is now able to give valuable mining technical instruction in connection with access to the various mines.

What were the relations of the American engineers to those from other countries?

In 1887 the total gold output of the world was about $107,000,000, while for 1914 the output of the Rand alone was in the neighborhood of $165,000,000, and of the world, $455,000,000. This phenomenal advance in the local industry brought in its train an urgent need for men from abroad experienced and trained in gold mining. This statement on its face also demonstrates the necessity for cultivating and advancing local talent. The Rand attracted engineers from all over the world. The American engineer was favored in the start through Hamilton Smith and H. C. Perkins, who were connected with the Rothschilds and who were also in touch with H. Eckstein & Co. and the De Beers Co. Through them Gardner Williams and Louis Seymour came to Kimberley, where the leading Johannesburg capitalists had their start, and myself and others to the Rand.

The English engineers, managers, and technical men were early on the spot and were strongly represented by such men as Sydney J. Farrar, J. Harry Johns, Fernside Irvine, Theodore Reunert, O. Lentz, C. J. Alford, J. Herbert Davis, Edgar P. Rathbone, E. J. Way, George Richards, G. A. Goodwin, H. R. Skinner, J. M. MacFarlane, Laurie Hamilton, F. Spencer, C. Rowe, A. R. Sawyer, K. D. Griffiths, E. H. Melville, G. R. Andrews, and later by Hugh Marriott, R. J. Frecheville, S. J. Speak, Stanley Clay, F. H. Hatch, S. J. Truscott, S. Hancock, David Gilmour, Kenneth Austin, E. F. Laschenger, and W. H. Wood. I must not omit the name of F. Raleigh, the secretary of the Crown Reef and afterward chief assistant to Mr. Webber. J. H. Curle was mill-man at the Nigel for a time while I was consulting engineer.

The Eckstein firm was instrumental in bringing to the Transvaal a large number of American technical men, among whom in earlier years were (in this list names of those arriving after 1903 are not included): 1887, J. S. Curtis; 1889, Sidney J. Jennings; 1890, Charles Butters, Joe Richard, John Walsh; 1891-2, Thomas Mein, O. H. Hahn, R. H. Harlan, W. W. Mein; 1893-4; H. C. Perkins, George E. Webber, E. A. Blanton, G. B. Poore, Richard E. Bowen; 1895, W. H. Hall, Eugene Hoefer, Palmer Carter and Lane Carter; 1896, Louis Seymour, J. S. Price, W. Bradford, and later, H. S. Stark, R. C. Warriner, and Maurice Robeson.

John Hays Hammond came out in 1893 for the Barnatos. He soon changed to the Gold Fields group and

introduced a number of Americans, among whom were George Starr, for the Barnatos, and Victor Clement, Pope Yeatman, H. H. Webb, R. V. Catlin, H. C. Behr, and Ernest Wiltsee for the Gold Fields.

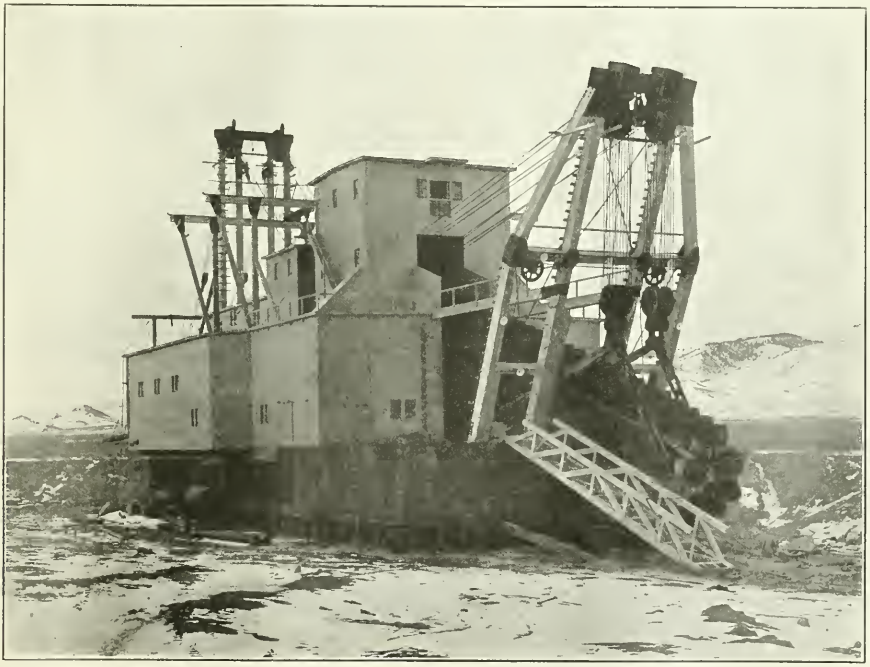
The Neumann group obtained in T. H. Leggett and F. Hellmann two other prominent American engineers, and George F. Becker, of the U. S. Geological Survey, made for them a geological report.

There were not many engineers of other nationalities: notable among these were J. Klimke, a Hollander, State Mining Engineer, R. N. Kotze, also State Engineer, a native of the Transvaal, H. Islin, Swiss, Schmitz Dumont, L. De Launay, a professor of the Ecole des Mines who wrote a treatise on the mines after his visit, as did Bergrath Schmeiser, a German government engineer.

Good relations existed between these men of diverse origins?

In the early years there was plenty of work for all who came to the Rand with good technical experience, and there was most cordial relations existing between the different technical men. The great influx of Americans was most generously received and treated by their English kinsmen. Certainly, I have reason to acknowledge the great kindness extended to me by them in both the Transvaal and London.

It was self-evident that it was wasteful, and soon impossible, to continue indefinitely the importation of expert talent from abroad and that the natural and right thing was to train the younger men while advancing the older ones that had demonstrated their ability. The sending of Royal School of Mines students from London and the founding of technical teaching in the Transvaal was certainly a right step for student-training schools. Many of these showed exceptional talent and it was a pleasure to advance them. At the time of my leaving I was gratified to see what able managers had been developed on the Rand. In consequence of this policy the American engineers who returned to their own country were not replaced by new importations and thus, at the present time, the number of American engineers on the Rand is far smaller than ten or twelve years ago. It is gratifying, however, to look back on the work done by Americans and see how they have done their full share in bringing about the great achievements of the Rand. Any impression that the American technical men did it *all* must be set aside. Taking all the names previously mentioned, it would be quite impossible, impolitic, and presumptuous to attempt in any way to adjudicate individual praise to the engineers, managers, and technical men cited. The results and history of the greatest goldfield in the world, more eloquently than any comment from me, speak for them.



ONE OF THE FOUR CONREY DREDGES. BUCKET, 16 CU. FT. DIGGING-MOTOR, 550 HP.

I would like to ask you if you think the Rand is a good training-school in preparation for other mining regions. Do not the relative uniformity of the ore and the big scale of operations militate against the

engineer's usefulness in districts where these conditions do not obtain?

The Rand has been a very limited school of late years for giving initiative in the investigation of new properties. Current methods in the Transvaal have been standardized by the great similarity of the problems to be solved at the various mines. however, it did and should still present a splendid field for experience in the handling of men and material on a large scale, and also in administration.

How about the Chinese experiment? Do you think that the introduction of the coolies was a wise step?

There were none in the Transvaal at the time I was there, but from reliable information I infer that it marked an advance in the application of low-grade labor. Even at a higher wage, the work of the Chinese averaged better than that of the Kaffir or native black African.

In other words, you consider that it was a pity that the importation of Chinese was stopped?

I do, on economic lines; and I see no moral ground why this scheme should have been abandoned.

When did you leave the Rand?

I left with my family in 1898 and went into the London office of Werther, Beit & Co. of which H. Eckstein & Co. was a branch. After the War I returned in 1902 and spent a year in aiding in the re-organization of the mines. My brother Sydney was then acting consulting engineer of the firm.

Did you find the work after the War interesting?

Most intensely so, as Lord Milner had initiated new constructive ideals and methods in all branches of civic life in Johannesburg. The mines had to be valued under new conditions and more broad and permanent lines laid down for their working. The deep-level problem had to be re-adjusted on a bigger-unit basis and in this connection the discussion, in which I took part, on winding from great depths, was most educating. Taxation and new political problems had to be met and technical educational matters were initiated, as I have already described. A descriptive and statistical statement of the gold-mining industry of the Witwatersrand was compiled and prepared by the engineers of the various groups of companies for Joseph Chamberlain, Secretary of the Colonies, who visited Johannesburg in January 1903. The committee of 15 engineers who drew up this report are as under: Hennen Jennings, Chairman; G. A. Denny, F. H. Hatch, F. Hellmann, G. J. Hoffmann, W. L. Honnold, S. J. Jennings, J. H. Johns, R. N. Kotze, S. C. Thompson, H. R. Skinner, H. H. Webb, G. E. Webber, P. Yeatman, and F. J. Carpenter, Secretary.

We went thoroughly into the past history of the goldfield; the yields, working costs, and statistics of past workings; the probable number of stamps that might be required in the future; the wages, living expenses, and relative proportion of natives and white men to bring about the best results in the future. It is interesting, in looking over this most exhaustive report with its tabular statements, to see how closely the future has established some of the predictions made therein. The statistical information was gathered and put together in a short time and it was only made possible by the whole-hearted cooperation of the engineers and the companies they represented.

You were in South Africa at the time of the Jameson raid. How did it affect you?

I will not pretend to take up the causes and happenings of the Raid, which has been the subject of so much writing. I can only say that I had the rare good fortune to keep out of jail and yet to hold the respect and esteem of my friends in it. After the Raid an effort was made to bring the necessities of the mines before the Government, and an Industrial Commission of Inquiry was appointed by the Government for this purpose with Schalk W. Burger as chairman. The Commission investigated matters most thoroughly and some 33 owners, engineers, managers, railway-men, etc., were called as witnesses. I took great interest in this work, and gave direct and cross-examination testimony extending over some three days during which I attempted to summarize the history and statistics of the mining industry to that date. Although the report of the Commission was broad-minded and favorable to the mining industry, it was not thoroughly acted upon by the Government. The Jameson raid started ill-feeling among the Boers, and this was fostered by their unrestricted importation of arms for three years, which of necessity meant war, as I realized before my departure.

After returning to London, on your leaving the Rand again, how long did you remain in England?

I remained with the firm until my departure to the United States in 1905, in the interim, however, making a visit to the El Oro district in Mexico. While in the London office I had many new propositions brought to my attention.

I remember you took a prominent part in the re-organization of the Royal School of Mines, and the development of mining education in London. You received the gold medal of the Institution of Mining and Metallurgy for your services in this regard, did you not?

The medal was not given me alone for my work in connection with technical education, but also for my connection with the mining industry in South Africa. In fact, the award was made before I had an opportunity of completing my work on the Departmental Committee of the Royal College of Science, but it is a generous and valued tribute from my English confreres. I received the appointment to serve on this committee in virtue of my being President of the Institution of Mining and Metallurgy in London at the time when the committee was created. My departure for the United States was made, as stated above, before I could complete my work, but our good friend Walter McDermott took my place. I consider it a great privilege to have served on this committee and believe it would have been a valuable object lesson to some of our Government committees to have

seen the dignity of the proceedings and the impartial way in which the questions were rotated to the different members of the committee and the varied lines of facts and thoughts evolved.

I believe that since your return you have, among other things, taken care of the McKay bequest to Harvard.

Yes. I have been connected with the Conrey Placer Mining Co., which started in 1898, operating in Montana, where there is now a fleet of four dredges at work, one as large as any in the world, namely, 16-cu. ft. buckets, 550-hp. digging-motor, and a 100-ton washing-trommel. This dredge in one month has dug as much as 411,000 cu. yd. from a depth of 54 ft. The dredge was evolved by a system of progressive development in dredging practice of which the early dredges started by Shaler were daring and useful pioneers. Gordon McKay, well known as a capitalist and inventor of leather-working machinery, in the initial stages of the enterprise advanced the greater part of the working capital and controlled the company. He took a keen interest in all the mechanical details of the dredges. A centrifugal pump designed by him has been worked with success and economy on several Conrey dredges.

Professor Shaler, Dean of the Scientific Department in Harvard University, acted as consulting engineer and president until the time of his death in 1906. He was active in all the affairs of the company and his geological attainments were valuable in the purchase of properties. He was also instrumental in bringing electrical power to the property. This venture brought Mr. McKay and Professor Shaler in close contact and knitted their friendship. At his death Gordon McKay willed almost his entire estate to the Scientific Department of Harvard University, but in a circuitous way, so that the University only obtains the full income by degrees. His very large interests in the Conrey company have given his estate, through dividends, retirement of stock, and interest on notes, something over $1,000,000, which should eventually enrich the Harvard Scientific Department by this amount, and should be further swelled by the future earnings of the company.

I understand that you are taking a great interest in the Pan-American Scientific Congress. What is it exactly?

This is the second Pan-American Congress, the first having been held at Santiago, Chile, in 1908. The present Congress was convened by Mr. Bryan, when Secretary of State, and is under the auspices of the State Department. The purpose is to bring together in friendly and cordial manner scientific men and societies of North and South America. An appropriation of $50,000 has been voted by Congress for the right entertainment and legitimate expenses, but this will probably not be sufficient for the publication of the papers, of which there should be a great number, and valuable. There have been a number of acceptances from South America and the Congress promises to be a large and important one.

You do not concern yourselves with the development of business relations between the Americas?

The Congress will be divided into about nine divisions, with separate chairmen. I am chairman of the Mining, Metallurgical, Economic Geology, and Applied Chemistry sections. While we have nothing in particular to do with business, we believe that the exchange of ideas will tend that way. The very fact that mining and metallurgy are fundamental industries will necessarily help business if they are advanced.

Mr. Jennings, may I ask you, did you participate in the profits of the mines with which you were connected?

Yes. In the latter years of my connection I had a definite participation in profits. My firm always encouraged me to invest in anything of intrinsic value with which I was connected. In this way I was able to make some fortunate investments, as I have never bought stock that I did not believe was worth more than I was paying for it, and I never bought more than I could pay for.

Do you approve of mining engineers speculating in mining shares?

I certainly do not believe in mining engineers or anybody buying mining shares on margin. An engineer, especially in his early career, should not lay himself open to criticism by having holdings unknown to the public in properties on which he is reporting.

Do you believe that the buying and selling of shares outright in any mine is apt to vitiate the judgment of an engineer?

Yes, I do, in the ordinary way of dealing in shares. In fact, I believe the Stock Exchange is a curse rather than a blessing to the mining industry. However, in working a property not quoted on the Stock Exchange, there is no reason why an engineer should not back his belief by putting his money alongside that of the owner.

You have had an unusually successful and honorable career; can you analyze the reason for your success?

I remember very well what Hamilton Smith said to me at the New Almaden mine when I was offered a salary of only $50 per month without board. He said: "Do not mind this salary, Hennen; do not think of your salary, but of your work, and one of these days you will be paid more than you are worth." Whatever success I have had has not been due to the possession of any particularly brilliant brain, but to hard work with interest in it, and to the coming into kindly contact with men about me, and in obtaining their assistance in the work I was directing.

HONDURAS has an area of 46,250 square miles, being larger than Pennsylvania. Its population is 600,000, of which 40,000 live in Tegucigalpa, the capital. The Pacific Mail steamers have been the only ones serving the country's Pacific coast, and service is infrequent and slow. The establishment of the gold standard would be a desirable reform; the silver peso is at present the monetary standard.

Heavy Timber Construction

By P. B. McDONALD

For the most part, the knowledge of heavy timber construction has to be learned from a boss-carpenter; there is no adequate book on this important subject. There have been articles published on the design of head-frames, trestles, etc., but this information is scattered, and many of the tricks of the trade never get into print. For instance, in the construction of a timber head-frame a mortice is the hole in which a tenon fits, but the tenon is so cut as to lack an inch of meeting the end of the hole, in order that the structure will tighten; and when the holes for the wooden pegs are bored, they do not coincide, but are non-concentric, so that the timbers will pull together, which is known as 'draw-boring.' Sometimes this space is not allowed for pulling together to make a tight structure; in such a case, a year or so after the head-frame is built, it will be liable to creak and groan when hoisting takes place, showing a loose condition—some head-frames sound like a blacksmith's bellows during hoisting.

The matter of 'sizing' and 'working face' are well

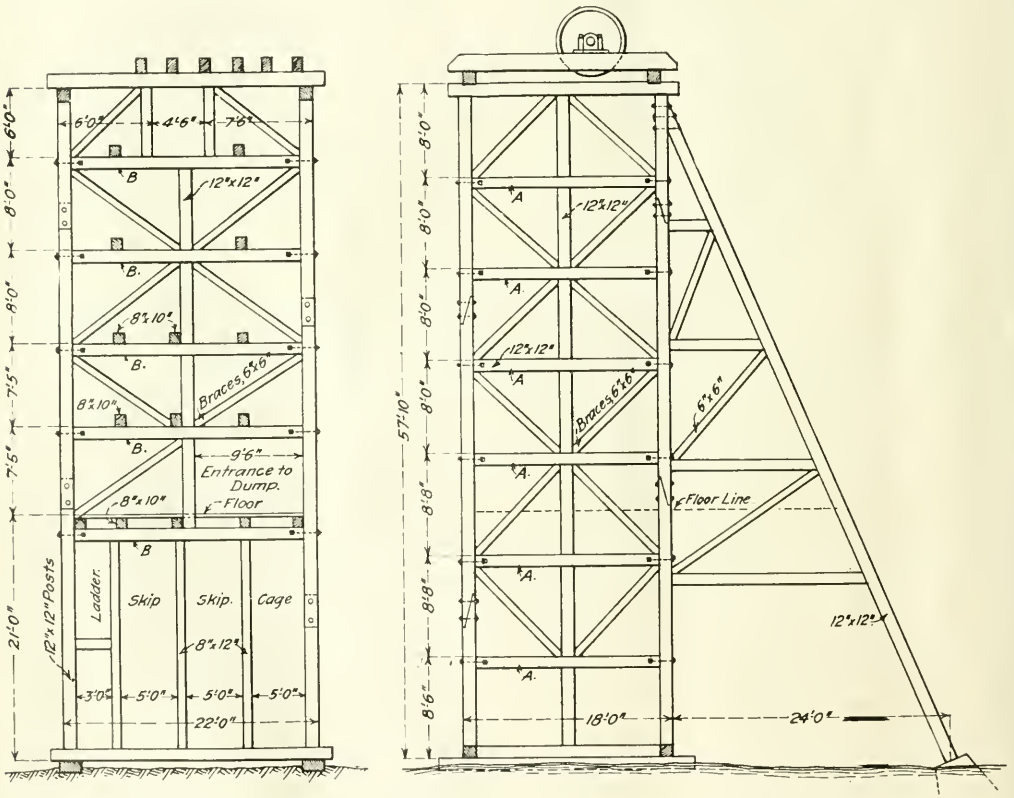


FIG. 1. TIMBER HEAD-FRAME, SHOWING EQUAL LENGTH OF MEMBERS MARKED 'B'; ALSO OF MEMBERS MARKED 'A.'

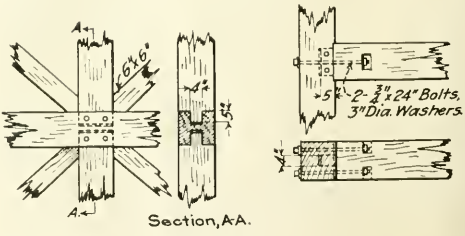


FIG. 2. DETAILS OF JOINTS.

known to a boss-carpenter, but not always to the mine superintendent. In Fig. 1, a timber head-frame is shown; incidentally, it is of the tower type with a back-brace, the original four posts being vertical. It is seen that the horizontal members marked *A* are all the same length, also the horizontal members marked *B*. Since this is so, the carpenters or timber-framers can frame up all the *A*'s at once and put them in a pile, and the same with the *B*'s. That is, any *A* should fit in any of the half dozen positions and each position does not need a certain definite member. This simplifies the work. But the posts must be exactly straight on the two sides where the *A*'s and *B*'s meet them. So a chalk-line is snapped on each post, and one face 'trued' for a 'working face,' after which the other face can be trued from it, if necessary. The truing may be done with an adze. Floor-girts have working faces trued on top. In some structures, perhaps an ore-pocket, a timber will be trued on opposite sides, indicating a centre-line.

Some details of joints of the head-frame above mentioned are shown in Fig. 2.

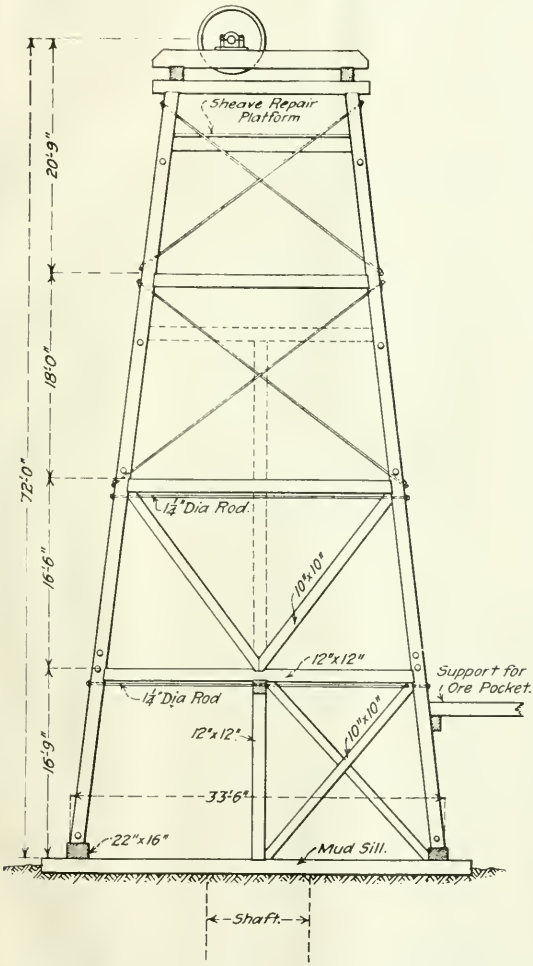


Fig. 3. HEAD-FRAME OF INCLINED-POST TYPE WITH TIE-RODS.

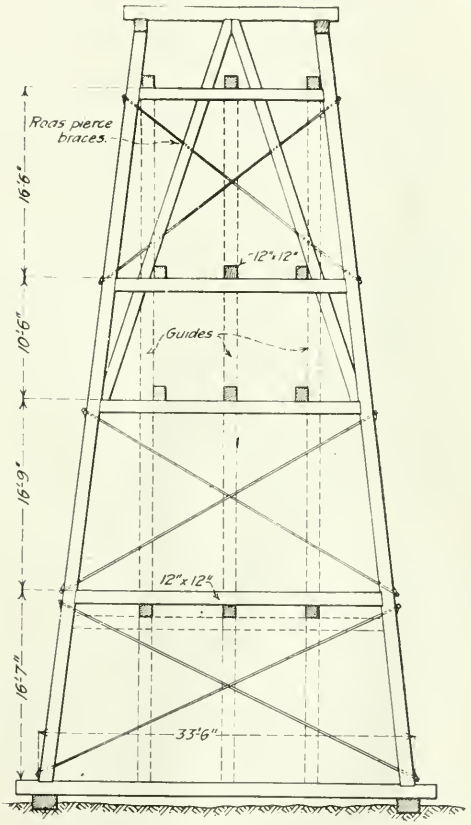


Fig. 4. FRONT VIEW.

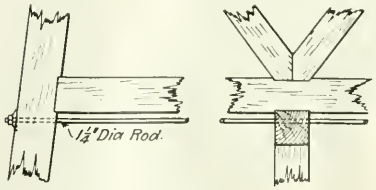


Fig. 5. DETAILS OF JOINTS.

Another simple wooden head-frame of the four-post type is shown in Fig. 3, while details of the joints are given in Fig. 5. It is seen that the posts are not vertical, and that iron tie-rods for tension members are used to

help the horizontal wooden members, and also for diagonals in place of wooden members. Such head-frames are not as economical in timber as the two-post head-frame popular in the Rocky Mountain states, and do not fulfill the technical requirements that the centre of the sheave shall be in a straight line with the back brace, but they are simple and easy to build, and are popular in regions where timber is plentiful.

For many rough structures at a mine, such as a coal-dock, and even for a small head-frame, it is not necessary that the timber shall be sawed, but round logs cut in the neighborhood can be used.

Treatment of Carnotite Ores for Radium

*The methods of extracting radium from carnotite ore as carried out in the plant at Denver have proved highly successful. They depend essentially upon the fact that strong hot nitric acid has a high coefficient of solubility for radium and barium sulphates. The method follows in brief:

The carnotite ore, pulverized to 20-mesh, is treated in a special earthenware leaching-pot with 38% nitric acid; 500 lb. of ore being used to 121 lb. of 100% HNO_3. The acid is brought nearly to boiling by means of steam passed through a glass tube and the ore gradually stirred in. Heating is continued for fifteen minutes when the acid is filtered from the ore in a stoneware filter. This is followed by a second treatment in the same leaching-pot with somewhat weaker hot nitric acid, after which the whole is washed with hot water. Nearly all of the uranium, about 50% of the vanadium, and over 90% of the radium are carried into solution by this method and separated from the bulky residue which is then discarded. The acid solution is nearly neutralized with sodium hydroxide, barium chloride, and sulphuric acid added in proper quantities and held in settling-tanks with conical bottoms for three days to settle out the radium-barium sulphate. The supernatant liquid is then siphoned into an excess of boiling sodium-carbonate solution to separate the uranium and vanadium from iron, aluminum, and calcium. The radium-barium sulphate left in the tank is filtered on a stoneware filter, washed, and dried, the washings being also added to the sodium-carbonate solution already mentioned.

The soluble sodium uranyl carbonate and the sodium vanadate are filtered from the iron calcium precipitates in filter presses and run into uranium precipitation tanks. The sodium carbonate is then nearly neutralized with nitric acid, and sodium hydroxide is added to complete the precipitation of the uranium as sodium uranate. The filtrate containing the vanadium is carefully neutralized with nitric acid, and iron sulphate is added to precipitate the vanadium as iron vanadate. Both the sodium uranate and the iron vanadate are separated from their solutions by means of filter presses. The filtrate from the iron vanadate consists almost wholly of a solution of sodium nitrate containing, of course, a small amount of impurity. This filtrate is evaporated, the sodium nitrate recovered and used again for the manufacture of nitric acid. The radium barium sulphate, without further treatment, is reduced in large graphite crucibles by charcoal, a very efficient conversion (90 to 95%) into barium radium sulphide being obtained. The sulphides are dissolved in hydrochloric acid and the residue of unchanged sulphates re-treated. The chloride solutions are crystallized in the plant in silica-lined kettles, care being taken to keep the solutions acid with hydrochlorie acid as the separation of radium from barium is much more rapid under these conditions. The concentrated chlorides carrying from 4 to 10 mg. of radium per kg. are taken to the laboratory, filtered from any insoluble impurities, and crystallized again in strong acid solution until the bulk has been reduced to a small volume, when they are converted into bromides. This is done after first neutralizing with ammonia and precipitating with hydrogen sulphide to remove the lead, which always accumulates and which is not precipitated by hydrochloric acid from strong barium chloride solution. After removal of the lead, the barium and radium are converted into carbonates by the addition of ammonium carbonate, washed, and dissolved in hydrobromic acid. From this point crystallization takes place in pure quartz dishes in solution strongly acid with hydrobromic acid.

The fractional crystallization of radium from the original chlorides to the finished product is neither tedious nor difficult, but takes place rapidly when acid solutions are used and when proper apparatus is available which will withstand their action.

A nitric acid plant has been erected which produces over 5000 pounds of nitric acid per day. Owing to the recovery of sodium nitrate the cost of the nitric acid has been very low, averaging slightly less than 2½ cents per pound. To September 1st, 4774 mg. of radium was produced in the form of sulphates and 1947.5 mg. in the form of bromide. Deliveries are continuing at the rate of 300 to 400 mg. per month.

The cost of radium figured on the basis of all the radium produced to August 1, which includes the higher costs of the earlier operations, was $37,500 per gram. The radium produced is being used in the Howard A. Kelly Sanatorium at Baltimore and the General Memorial Hospital, New York City, for the treatment of cancer and other malignant growths. A copy of the bulletin may be obtained by addressing the Director, Bureau of Mines, Washington, D. C.

*From U. S. Bureau of Mines Bulletin 104 by Charles Parsons, R. B. Moore, S. C. Lind, and O. C. Schaefer.

Scheelite when pure is a tungstate of lime. It has a hardness of 4 to 4½, with a specific gravity of 6, and a good cleavage. In color it is yellowish brown.

CONCENTRATES

Readers of the MINING and Scientific PRESS are invited to ask questions and give information dealing with technical and other matters pertaining to the practice of mining, milling, and smelting.

A SILICA-GRAPHITE PAINT will prevent hot-water pipes from rusting, also from the corrosive effect of brine and other fumes.

ITEMIZED PARTICULARS of work performed on mining claims for assessment is not necessary in affidavits stating that such work has been done, but it is better if the important details be stated.

A SIMPLE TEST for tungsten ores is to treat a small quantity of the ground material with hydrochloric acid in a test-tube. If the metal is present a canary yellow will be seen. To make sure of the test add a scrap of tin, which will give a blue coloration.

TAMPING BALLAST under railroad-ties is tedious and occupies considerable time; but this work is made easier and better by using a pneumatic tie-tamp, consisting of a hammer weighing 37.5 lb. complete. The track settles at a rate half that when hand-tamping is employed.

MINES in the Kolar field, State of Mysore, India, have produced $214,126,000 in gold, with a bright future. They are opened to 4900 ft. vertical, the veins showing remarkable persistency. The State government sells hydro-electric power and water to the companies, receiving $973,300 per annum for this service, with taxes.

ACETYLENE, mixed with oxygen, as is well known, forms the oxy-acetylene jet used in welding or cutting metals, but according to experience of the Pacific Gas & Electric Co., it is foolish to attempt to manufacture the gases on the job. They can be bought in cylinders or tanks under pressure of 100 atmospheres (1500 lb.), costing 1.75 to 1.9 cents per foot delivered.

MANGANESE-STEEL ventilated heads for large gyratory-crushers are now made, a recent one weighing 21,360 lb. They are provided with a series of vertical flues or cores running from top to bottom, which permit a circulation of air between the wearing-surface and the shaft or spindle. This tends to prevent the transmission, from the wearing-surface to the shaft, of the heat incident to crushing. As compared with a solid head, the weight is reduced from 20 to 30%.

TUNGSTEN is ductile, paramagnetic, has the highest melting point of the metals, is practically insoluble in ordinary acids, and its tensile strength exceeds that of iron and nickel. It is used in incandescent lamps because it can be drawn to smaller sizes of wire than any other metal. Patent No. 1,163,329 has recently been granted to Thomas A. Edison for a process for forming a film for an incandescent-lamp filament. The method consists in vaporizing tungsten by an electric discharge *in vacuo*, depositing the same on a surface in the path of the discharge, and separating the film thus formed from the surface.

SAMPLING a drill-hole by dynamite was successful at a mine near Joplin, Missouri, recently. The hole was down 195 ft. in ore. A tin 'torpedo' 10 ft. long was made and charged with 50 lb. of 40% gelatine-dynamite. The two detonators were connected by insulated wire, and the whole lowered into the bore. The blast was set off by an electric battery, resulting in water and rocks being shot up 70 ft. into the air. Assays were made of the ore blown out, indicating fair sheet-ground.

EUCALYPTUS OIL is used exclusively in Australian flotation-plants, where it is cheap and efficient. According to P. W. Tompkins in *The Journal of Industrial and Engineering Chemistry*, in discussing the eucalyptus-oil industry of California, and comparing the product with that of Australia, he considers that the by-product oil of refining as well as the crude (if sufficiently reasonable and in quantities) might be utilized for the separation of metallic sulphides by the flotation process, as extensively applied in Australia. Eucalyptus oil has been used to a small extent in flotation work in California, but for the most part the oil was imported from Australia.

ACETYLENE LAMPS are largely used in mine lighting, but there are occasional explosions. The explosibility of the gas has been investigated by George A. Burrell and G. G. Oberfell, of the U. S. Bureau of Mines, who conclude that the smallest proportion of acetylene capable of propagating flame in a mixture of acetylene and air is 2.53%, and the largest proportion 73%. Acetylene, not mixed with air, is explosive under a pressure of 3 to 5 atmospheres (45 to 75 lb.) when an electric spark is passed through the mixture, or when a platinum spiral is heated in it. The danger connected with the handling of calcium carbide in a mine is remote if reasonable care is observed in handling.

COUPLINGS are those machine parts that are used to connect the ends of two shafts or spindles so that rotation of the one will produce an identical rotation of the other. They may be either permanent or disengaging fastenings; the latter are frequently called clutches. Sleeve or muff-couplings are simple in operation, holding the two shafts by a key in a keyway and sleeve; flange-couplings are also common. Disengaging-couplings or clutches may be either positive or friction-drive, the former being generally called toothed or claw-couplings. Friction-couplings usually consist of a hollow, rigid cone, and a sliding-cone, although band-clutches operate somewhat on the principle of friction-brakes. To allow 'give' between, say, a high-speed engine and a generator, a flexible-coupling is generally used.

REVIEW OF MINING

As seen at the world's great mining centres by our own correspondents.

BUTTE, MONTANA

Butte.—Anaconda and Zinc.—Butte & Superior.—East Butte.—Alice,—Butte & Bacorn.—Butte-Ballaklava.—Anaconda and Emma.—Davis-Daly.—Butte & Zenith.

A visitor at Butte is at once struck with the bustle and air of prosperity of the place. All of the copper-producing companies are working at full capacity. The two zinc mines, the Butte & Superior and Elm Orlu, are extracting 1750 and 600 tons per day of zinc-silver ore, respectively. Developing companies are experiencing little difficulty in raising money, and claims change ownership frequently.

Construction of a 100-ton zinc-reduction plant has been started at Great Falls; it is expected to have it completed in September 1916. The estimated cost is $2,000,000. The laboratory tests were made at Anaconda, and an experimental plant with a capacity of 10 tons of zinc per day showed that the process is practicable. While details have not been fully worked out, the following system has been productive of good results: The zinc occurs as sphalerite in a granite gangue. Sulphides of iron, lead, and copper are also present in the ore. The silver-content averages about 4 oz. per ton. The ore is ground to 40-mesh, and given a dead roast. Sulphuric acid is added, dissolving the zinc, iron, copper, and impurities. Lime is added to neutralize the solution and precipitate the iron. The copper is precipitated with zinc-dust. The solution is filtered by an Oliver machine, and the zinc is precipitated from the clear solution by electrolysis. The filter-residue contains the lead and silver, and when of sufficient value it will be sent to a lead smelter. Great Falls is the logical location for a plant of this type, as plenty of cheap power can be generated.

The quantity of ore mined during the third quarter, ended September 30, was the largest in the history of the Butte & Superior company; the tonnage for October and November exceeded that of the two corresponding months of the third quarter. Work has started on one of the two new shafts to be sunk. It has been customary in the Butte district to make the large shafts with four compartments. Two of these are used in hoisting ore in counter-balance; a chippy-cage runs in the third compartment, and is used for lowering timber, and for transferring bosses and men from one level to another; the fourth compartment has the water-column, electric cables, and ladder-way. Difficulty has been experienced all over the place in keeping these large shafts straight. Even those sunk in granite at some distance from the veins cause trouble because of the tendency of the ground to get heavy. The Butte & Superior has decided to sink two shafts, one of two and the other of three compartments, with a 50-ft. block of ground between them. The two-compartment shaft will be used for hoisting ore. One compartment of the other shaft will be used for the water-column, ladder-way, and cables, and the other two will be used for the timber-hoist, which will work in counter-balance. Running the timber or chippy-hoist in counter-balance will effect a large saving of power. The shafts will be sunk from the surface to 700 ft., and will be raised from 1800 to 700 ft. Sinking is still underway in the old shaft which is down below 1800 ft. Ore is being stoped from the 700 to the 1600-ft. levels.

A vein in the Col. Sellers claim of the Butte-New York is being opened with encouraging results. The work is being done by the Butte & Superior company on its 1200-ft. level, through the Black Rock shaft.

The East Butte company started the month of December without a debt. The original debt created by the purchase of Pittsmont property was $2,000,000, all of which has been paid off from the profits of the last six years. Earnings in September amounted to $170,000, and on 18c. copper the company's profit is more than $2,000,000 per year. Preparations are being made to sink the Pittsmont shaft to the 2100-ft. level. Between 1500 and 1800-ft. level a wet, heavy fault was cut, and sinking had to be suspended until the flow of water abated. Development at 600, 700, 800, and 1500 ft. has opened ore reserves that average 4% copper. The flotation annex to the concentrator is practically complete, and is expected to be in operation on January 1. The plant now has a capacity of 900 tons per day.

Twenty-five men are working at the Alice, overhauling the surface buildings, repairing the shaft, and getting ready to unwater the mine. No work has been done on the property since last spring, when the minority stockholders brought proceedings to set aside the sale to the Anaconda company, which had traded 30,000 shares of Anaconda stock for the Alice properties, and assumed the Alice company's debts amounting to about $40,000, as has already been mentioned in the Press. The Alice litigants objected to the manner in which the Anaconda took over the Alice, and claimed that the consideration was inadequate. The court ascertained that the price paid for the Alice was $1,904,391, and as no other bid was made, the sale to the Anaconda company was allowed to stand. It was also decided by the Court that the Alice stockholders, if they preferred, should be paid in cash instead of Anaconda stock. The Alice group includes the Alice, Magna Charter, Curry, Valdemere, Rooney, Hawkeye, Reef Fraction, Magnolia, Boston, Cottonwood, Plover, Saukie Weast, Rising Star, Midnight, and other claims of less importance. It was a famous silver producer in the early history of Butte. Many of the claims are on the Rainbow lode, the big vein that is being worked for zinc by the Butte & Superior and Elm Orlu companies, and it is thought that large zinc-silver orebodies will be opened.

Efforts are being made to re-organize and raise sufficient money to pay off the debts of the Butte & Bacorn company, and provide a working capital with which to continue development. The company owns 300 acres in the north part of the Butte district, and surface indications warrant development at depth.

Two hundred tons per day of 3½% copper ore is being mined at the Butte-Ballaklava. The shaft is down 1600 ft., from which point a winze is being sunk on the vein, and as soon as it is down to the 1800-ft. level driving will commence. Development is underway at 900, 1000, 1200, 1300, and 1600 feet.

Much development work at 2500-ft. has resulted in cutting the Hesperus orebody of the Davis-Daly. About 50 tons of 5% copper ore is being mined per day, and a cross-cut is being driven in a southwest direction to pick up the faulted extension of the vein.

Development will soon be resumed at the Butte & Zenith. The shaft is down 670 ft., and the equipment is ample for a depth of 1500 ft. From the surface to 500 ft. the shaft was in granite. From that point it was sunk in a vein that is not traceable on the surface. A cross-cut north and south at 460 ft. cut four veins, all somewhat mineralized. The shaft will be sunk to 1000 ft., and the veins will be prospected at that

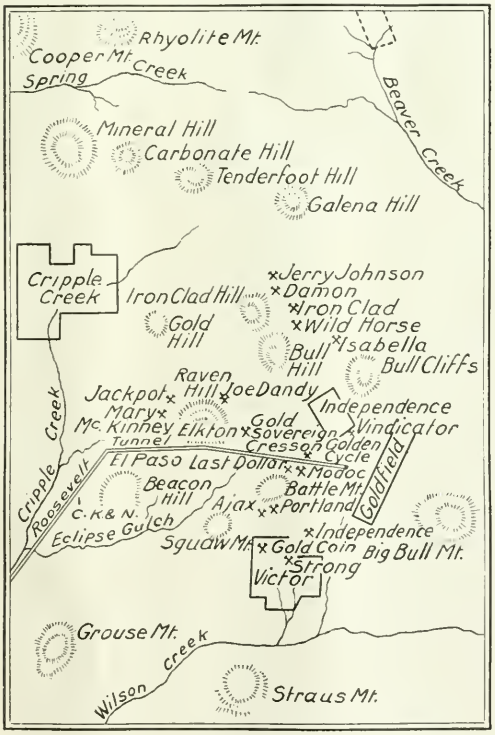
depth. The property consists of 22 claims, and is situated four miles west of Butte. The geology in many respects is similar to that surrounding the producing mines of the Butte hill. The country-rock is granite with intrusions of aplite and rhyolite. East, west, and north-west veins can be traced for thousands of feet on the surface. Walter Harvey Weed examined the property.

The Anaconda company has leased the Emma claim, which is the old silver producer at the corner of Colorado and Silver streets. Cross-cutting on the 400-ft. level has disclosed some 30% zinc ore. The vein is 30 ft. wide at that point. The showing was so promising that the Czarroma and Travonia Fraction, claims adjoining the Emma, were purchased for $250,000.

CRIPPLE CREEK, COLORADO

Weather Affects Health.—Drainage-Tunnel.—New Mill.—Freight.

The past two weeks have been so pleasant (warm and dry) that much sickness has resulted; nearly every person in the



THE CRIPPLE CREEK DISTRICT, COLORADO.

district has had a more or less severe attack of *la grippe*. In some cases so many men were away from their work on account of illness that the production of ore was likely to be curtailed. At one time it was reported that the Portland company had more than 50 men unable to report for work. With the light snowfall of the past two days the situation has been relieved, for the present at least.

According to T. R. Countryman, engineer for the Roosevelt drainage-tunnel, the advance was nearly 300 ft. during November. Soon after the first of December the flow from the portal was in excess of 15,000 gal. per minute. Since then, however, the heading has entered harder and tighter ground, and the flow has decreased to a little more than 13,000 gal. The breast of the Tunnel is now less than 500 ft. from a point directly under the Elkton shaft.

Excavation for a mill-site has been started at the foot of the main dump of the Ruble shaft on Bull hill. The Rubie Mining & Milling Co., incorporated November 27, proposes to erect a cyanide mill for the treatment of ores from the Rubie and Lafayette mines and dumps. The new mill will be called the Worcester. It will use the straight cyanide process, and will have a crushing capacity of 50 tons daily. The officers of the company are: S. A. Worcester, president and general manager; Harry L. Walker, vice-president and treasurer; S. A. Worcester, Jr., secretary; and Wm. A. Quigley and Chas. D. Gurney, directors.

A new freight rate on high-grade ore shipped from the district to the valley mills went into effect on November 24. The new rate on ores of a value of $100 per ton is $2.50 per ton, plus 1% of the assay-value, in excess of $100 per ton.

DEADWOOD, SOUTH DAKOTA

New York Capital Commences Work.—Resumption of Operations in Hornblend District.—Homestake Increases Capacity.—Wasp Tungsten Ore.

Financed by a group of New York men who have never before been interested in South Dakota mines, the property and equipment of the Imperial Gold Mining Co. has been taken over by the Ofer Gold Mining Co. ('Ofer' is the name of one of the mining claims embraced in the transfer, and so designated by its original locator, who in harking back to Bible times, got his orthography rather mixed). The Ofer company thus comes in possession of some of the choicest ground in the Trojan district, surrounded by holdings of the Trojan and Mogul company, as well as the American Express and Chicken group, on the divide between Blacktail and Sheeptail gulches. Ores are now being produced from the Burlington and Apex group, at Trojan, and from the American Express. The first-named group has been leased by the Mogul company, which, in opening a valuable ore-shoot, followed it right up to the claim line, and gladly secured the privilege of continuing into the Ofer ground. This production is of course going to the Mogul mill. The ore from the American Express is being shipped *via* the North-Western railroad to the New Reliance mill at Trojan. This work is being done by the lessees, Phillips and Carretto, of Central City. It is probable that next spring the Ofer company will either buy or erect a cyanide-plant. The old Imperial mill at Deadwood, arranged for dry-crushing and cyaniding, was constructed in the early days of this process, and is not considered efficient or conveniently situated. The new mill will be closer to the mines. W. S. Elder, of Deadwood, is general manager.

In preparation for resumption of work, the Golden West company has been re-organized as the New Golden West Mines Co. Holders of stock and bonds in the old company are to receive shares in the new one on the basis of 10c. a share for preferred in the new corporation at par; each share of new preferred carrying with it one share of new common stock. The capital is $2,000,000, one-half of which is preferred 7% cumulative dividend and the balance common, to share earnings equally with the preferred after the preferred 7% dividend has been paid. The company's property, which has many times been referred to as one of the best prospects in the Black Hills, is in the Hornblend district, west of Rochford. About 12 years ago a small mill was erected, and considerable oxidized ore mined in an open-cut was crushed, and some of the gold saved by amalgamation. When the harder, unoxidized ores were reached, some of the backers got 'cold feet' and work was suspended. It is to be hoped that the new

venture will be successful. As it is amply financed—the backers including some of the big men of the International Harvester Co.—lack of money will not be the excuse offered.

Increased mill capacity is to be secured at the Homestake by means of heavier stamps and secondary crushing. The stamps, long regarded as light, are to be increased from the present average of 900 lb., to one of 1000 lb. This, it is estimated will give about 10% additional stamp-duty. Secondary crushing will permit another 8% increase in reduction. The latter change will come with the starting of new equipment at the B. & M. shaft. Here, skips will dump into No. 8 Gates crushers, and their product carried by belt-conveyors to smaller gyratories. These changes should be completed within a few months; the B. & M. shaft equipment, new boiler-plant, etc., is nearly completed, and the increasing of the stamp weight is comparatively simple. The Homestake's new machinery at Lead includes a steam-driven electric-generating station with a maximum capacity of 4000 kva., which will, working in step with the hydro-electric plants of the company at Spearfish and Englewood, furnish sufficient power at all times of the year to drive all of the company's machinery except the hoisting-engines, which will continue to be operated by steam-power.

Good progress is being made by the Wasp No. 2 company in installing concentrating machines to treat low-grade wolframite ores, that have accumulated during several months of hand sorting of high-grade material, which has gone direct to the market. It is estimated that the dump contains $100,000 net of the tungsten ore. Production continues; 30 tons was shipped this month, realizing over $1800 per ton. A dividend of 5c. per share was declared on the 15th; next month's payments will probably be larger, as the concentrator should be working and returning profits by that time.

MELBOURNE, AUSTRALIA

Condition of the Metal Industry in Australia.

The metal trade of Australia is being welded into fresh form by the hands of the Commonwealth Attorney General and Prime Minister (Mr. W. M. Hughes). This Welshman is as vigorous and as daring a personality as is his countryman, Lloyd George. His career is typical of what can happen to a man with brains and strength of purpose in a democratic community like Australia. In the lowest walk of life at first, he associated with the wharf-laborers union, where his command of language and general capacity soon won for him the secretaryship of that organization, and next gave him a seat as the representative of Labor in the Legislature of New South Wales. There he sharpened his wits, broadened his ideas, and developed his brain by qualifying himself for the profession of a barrister. That achieved he stepped into the Federal Parliament as one of the two brainiest men in Labor ranks. The temporary victory of his party a few years since yielded him his first taste of office. The wholesale defeat of the Liberal party at the start of the War put him as second in control in the Government of the Commonwealth. Now the retirement of his old chief, Andrew Fisher, to take up the representation of Australia in London, furnishes Attorney-General Hughes with the most coveted position in Australia, that of Prime Minister.

This preliminary is necessary to explain the position of the metal market in Australia. Prior to the War, the great German houses of the Mertons, Hirsch, and Beer Sondheimer, with lights of less magnitude, had worked their way into the metal trade of Australia. That trade, on the face of it, represented annually from £12,000,000 to £14,000,000. The chief prizes originally were the handling, treatment, and subsequent sale of the lead concentrate of the great silver-lead district of Broken Hill. Then, as the flotation process developed there was added the output of zinc concentrate. In connection with this trade, Henry R. Merton & Co. controlled the organization known as the Australian Metal Corporation; in zinc came Beer Sondheimer & Co. Both these firms also were interested in lead and copper, but Aron Hirsch & Sohn was the biggest firm operating in the latter metal. The most solidly established house was the Merton organization, for it had the wealth of the Metallgesellschaft at its back. Its strength was such that it induced the Broken Hill Proprietary Co. to join the Lead Convention, and it had a large hand in creating the Zinc Convention, both of which fell to pieces when hostilities began. Owing to under-quoting, and to the gradual exhaustion of its mine, the Broken Hill Proprietary Co. had ceased to be the prominent figure it once was in the metal market save in the Far East. Owing to the high price of labor and other reasons that need not be detailed it could not afford to quote so low a returning charge as the German metal-buyer. Thus it lost the smelting of the output of some of the most important of the Broken Hill mines. As its ore reserves became depleted, a rival group that had let the product of their mines go abroad decided to get the control of the field. To do this they had either to buy the smelters at Port Pirie of the Broken Hill Proprietary Co. or start new works of their own. An attempt at purchase made some three years ago failed. The War changed everything, and as the Proprietary Co. was hard at work establishing large iron and steel works at Newcastle, New South Wales, what previously was impossible became possible. The group was enabled to buy a two-thirds interest in the Port Pirie works, on behalf of the North and the South Broken Hill companies, the Proprietary Co. retaining the remaining third interest. Since then other mines have joined the new organization, whose aim seems to be to control the bulk of the lead, silver, and zinc output of Broken Hill. It is avowed that this is to be done on a co-operative basis, that is, that the one aim of the promoters is the advancement of the interests of the shareholders of the affiliated companies. As the new central organization has a 50-year contract for the lead output of the leading companies, to its smelters will go the lead concentrate of Broken Hill for treatment. Germany therefore by one stroke seems to have been cut out of any future participation in the lead industry. The position is that the country has, in the Associated Broken Hill Smelters Co., an organization that controls the greater part of the lead output of Broken Hill. As to copper, the Electrolytic Company working at Port Kembla, in New South Wales, was owned mainly by the Mount Morgan Company and by Aron Hirsch interests. Here London influences, owing to a large investment in Mount Morgan shares, came into play. These were in touch with interests that dominated several mines in the copper region around Cloncurry in northern Queensland. So here was the basis of a second combination of the elements likely to cohere, although the Mt. Lyell and the Wallaroo and Moonta mines could not be brought into line unless they cared to do so. The tin smelting industry was represented by three concerns, of which the leader was the Mt. Bischoff in Tasmania. Their smelting charges, however, were such that a great deal of tin ore was sent from Australia to the Malay Peninsula to be treated and sold there. As for iron, the only concern of any size to tackle the problem of turning the resources of the Commonwealth to account was the Broken Hill Proprietary Co. at Newcastle. Antimony, wolfram, molybdenum, and other of the rarer minerals were all exported to Germany or went through German agents to different parts of the world.

All this trade in the export of lead and zinc concentrate was thrown into confusion on the outbreak of the War. A number of mines had to close down for a while, and others, like those at Broken Hill, could only work intermittently. The Broken Hill Proprietary came to the aid of the South Broken Hill and North Broken Hill mines by smelting for them at bare cost, but the mines could not make deliveries. Before long, however, the presence of Mr. Hughes began to be felt. He raided certain offices and the premises of firms connected with the metal trade. Following this he denounced as un-British and

undesirable the hold foreigners had on the metal trade of Australia. Next he set to work to smash certain trade connections with German buyers. The War had caused a suspension of all buying contracts. This was not sufficient for the doughty little Welshman. He demanded that there should be no dealing with firms or corporations that though British from the point of domicile were in fact German-controlled. His attitude in this respect went far ahead of what was done in Great Britain, but it had popular opinion behind it. Finally he passed legislation permitting companies or firms having contracts with German firms to annul them. Of course, where the companies were domiciled in Great Britain and the contracts signed there, he could not interpose. Still, his policy has had widespread support there, though as yet the British authorities have declined to follow Mr. Hughes' initiative. In Australia the controllers of a number of the mines were at first resentful and perhaps contemptuous. They had had the control of their properties so long under State law and under peace conditions that they could not understand being rounded up, as was being done by the Federal Attorney-General. A most remarkable pledge was exacted from the Broken Hill Proprietary Co., not to deal through the Merton houses in London. When certain people associated with the Mt. Morgan property applied for permission to act as agents for that firm. Hughes made them the subject of biting criticism. While doing this, he formulated the idea of establishing a metal exchange to handle the metal output of the country. Now that organization is at work. The reason it was constituted was to prevent powerful interests connected with the mines from shutting out locally established agents of British and Colonial houses from having the right to buy and sell metals in an open market. To ensure the elimination of the foreign element, transactions have to be carried out through the Exchange. If that is not done the Executive has to be satisfied that exports are intended for purely British consumers, for the Allies, or for approved firms in neutral countries. In short, the export of metals now is under State control.

Nor is this all: The aim of the little Welshman is to destroy the grip of the German on the Australian metal trade forever. He hopes to achieve that not only by the use of the legislative power at his disposal—a power that the British Parliament cannot touch unless it interferes with Australian self-government—but by granting assistance to industry here to establish manufactures out of the raw products hitherto sent abroad. One of his grounds of complaint in respect to the Electrolytic Company, referred to above, was that it had not responded to his request to promote a scheme for using the refined copper in manufacture. Here again Hughes is in accord with public sentiment, for this country has had forced upon it by the dislocation of trade at the outbreak of the War—the necessity for being self-contained in that respect. Still, it isn't clear that with hostilities at an end and with Australia a self-governing country, that the great markets hitherto utilized in Germany and elsewhere can be ignored. The population of the country is too sparse to allow of that, but it is certain that the 'made in Australia' call will be heard in a more incisive tone than ever. State regulation to enforce the policy initiated by Hughes will also be an accepted canon in public life. Lead and copper have been found to be easy to control so far, but it is different with zinc ore and concentrate. The quantity of ore carrying zinc in profitable quantity is not sufficient to justify, without heavy State backing, the outlay of capital necessary to enable zinc-distillation plants to be erected in Australia. Under considerable pressure, however, it now appears as if the Attorney-General is succeeding in getting the British authorities to co-operate in putting up works in England to which the Australian output shall go. This will meet national sentiment though it may clash with the re-opening of works in Belgium, to which hitherto, under German direction, our zinc concentrate has gone in vast quantities. As regards iron and steel, the Broken Hill Proprietary has established its works at Newcastle. There has never been a hitch over the enterprise. This has been due, first of all, to the persistence of the general manager, G. D. Delprat. American experts secured by him have built a steel plant at Newcastle that is second to none in efficiency. Australia now has started on the road to becoming practically independent of outside sources of supply of pig-iron and steel. It can be taken for granted that the State will not allow this iron and steel manufactory to suffer by dumping tactics. Already its usefulness in defense is being illustrated by the fact that the company is producing steel for the manufacture of munitions and that its output is wanted by makers throughout the Commonwealth. As Australia produces a fair proportion of the world's yield of wolfram and molybdenum, these minerals are available for use as alloys, though at present they, as well as antimony, are commandeered for the War Department.

The trade in tin ore is also likely to be regulated. A good deal of the ore sent hence to the Malay Settlements to be smelted will, if the ideas of the Attorney-General be adopted, be treated in Australia. It is hoped that the Broken Hill Proprietary will be able to utilize some of this tin in making tin-plate, just as the wish exists that, with zinc available, it shall engage in the manufacture of galvanized iron. Protection would be accorded, if necessary, and in all probability a leaf would be taken out of the German book in the matter of granting a big subsidy for the establishment of these industries. In conclusion, the broad fact is that the whole metal export trade of Australia is today under Federal control and direction. That control aims at the destruction of German pre-War connections with the metal and mining industries of Australia, and to make Australia more self-contained.

WASHINGTON, D. C.

Mining Law Revision.

During the meeting held at the Smithsonian Institution here, on December 16 (three sessions), the Mining and Metallurgical Society of America took a decided stand in relation to the appointment, by authority of Congress, of a commission to codify the mining laws of the country, and at the same time that a permanent committee of mining law revision would also be established, to consist of 15 members. The meeting was attended by 125 registered delegates, other mining institutions, etc., collaborating with the Society. The presiding officer over the first session was Carl Scholz, president of the American Mining Congress. He made a felicitous address; also one by Franklin K. Lane, Secretary of the Interior. Committees were appointed, that on resolutions being headed by Horace V. Winchell. Six resolutions were adopted, one being that the mining law be revised as a whole, not piecemeal. The resolutions were not adopted without discussion and attempts to amend them. It was proposed that the resolutions bearing on the codification commission be made to include Alaska, but it was shown that this Territory had mining laws of its own, independent of the United States. R. Macbeth of Idaho protested against any officer of the United States government being included in the commission. He was seconded by E. P. Smith of the same State. J. Parke Channing, as a conservationist, gently took issue with Mr. Macbeth; also Chambers Kellar, of South Dakota, and Edmund B. Kirby. The Macbeth amendment was lost by a considerable vote. The evening session was presided over by W. R. Ingalls of the M. & M. Society, succeeding W. L. Saunders, of the A. I. M. E., who presided in the afternoon. Among those in the audience were Senator Myers of Montana, and ex-Senator Clark from that State. Horace V. Winchell read a thoroughly prepared paper on mining conditions with respect to the laws, and Senator Thomas of Colorado made an address also on mining law conditions. He was followed by Senator Walsh of Montana in an elaborate paper.

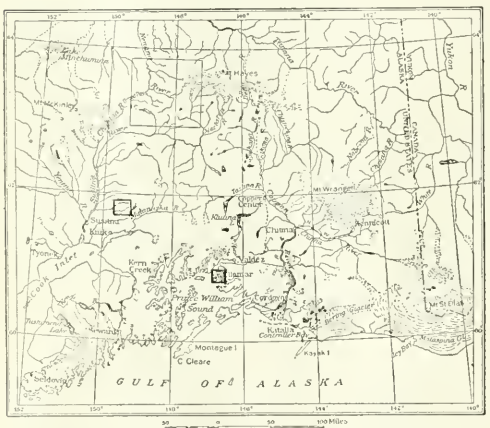
The U. S. Bureau of Mining, in charge of Van H. Manning, assisted the visitors in many ways.

THE MINING SUMMARY

The news of the week as told by our special correspondents and compiled from the local press.

ALASKA

Three interesting bulletins, No. 605, 607, and 608, have recently been issued by the U. S. Geological Survey. They are 'The Ellamar District, Alaska,' by S. R. Capps and B. L. Johnson; 'The Willow Creek District, Alaska,' by S. R. Capps,



PART OF ALASKA. THE AREAS WITHIN THE SQUARES ARE THOSE DESCRIBED IN THE SURVEY BULLETINS MENTIONED.

and 'The Broad Pass Region, Alaska,' by Fred H. Moffit, and Joseph E. Pogue. The situation, climate, geology, ore deposits, and details of mines being operated are given.

Charting the Kuskokwim river in Alaska has been completed by the U. S. Coast and Geodetic Survey during the past season. Among the rivers of Alaska, the Kuskokwim is second only to the Yukon in size, but on account of the large area of hitherto uncharted mud-flats at the river's mouth, it has been visited by only two or three small steamers during the year. The channel through these flats has been charted now. As a supplement to the coast work, a reconnaissance survey was made inland from Bethel, the head of deep-water navigation. By the use of the steamer *Yukon* this was carried up-stream 550 miles to McGrath, the main settlement on the upper river. Earlier maps of the river were found in some places to be as much as 50 miles in error.

JUNEAU

On account of the lower grade of ore mined at the Perseverance mine, the Alaska Gastineau company has reduced the output from 6000 to 4000 tons daily. This raised the value from $1 to $1.40 per ton. Plans have been devised to remove the 'horse' of schist that was the cause of the lowering of the grade.

KETCHIKAN

The geology of Gravina island, just across a narrow channel from Ketchikan, is discussed by Philip S. Smith in *Professional Paper* 95-H. of the U. S. Geological Survey. Whether commercial ores exist is not mentioned.

FAIRBANKS

According to the *Fairbanks Weekly Times*, which published the following table prepared by George Hutchinson, cashier of the First National bank, with the assistance of the officers of the American Bank of Alaska, and with suggestions from the agent of the Wells Fargo Express Co., the gold production of the Fairbanks district for the season 1915 was as follows:

Cleary and tributaries and Chatanika district	$ 667,000
Fairbanks creek and tributaries	262,000
Pedro and tributaries	327,000
Goldstream and tributaries	321,000
Little Eldorado	65,000
Dome	268,000
Vault	106,000
Ester	380,000
Other creeks in Fairbanks region	40,000
Placer production	$2,436,000
Quartz production	250,000
Total Fairbanks region	$2,686,000
Hot Springs	600,000
Tenderfoot	72,000
Tolovana	60,000
Outlying districts	43,000
	$3,461,000
Antimony, approximately 1000 tons	150,000
Total production	$3,611,000

The output is larger than in the two previous seasons. Some of the districts promise well for the future. The Tolovana output was made under unfavorable circumstances. The yield from quartz was lower, but next year it should be larger.

The mortgager of the Newsboy quartz mine, Mrs. A. E. Golden, has brought suit to foreclose on the property. There is $20,021 interest, costs, and fees due. The plant includes a boiler, compressor, crusher, five-stamp Joshua Hendy mill, engine, etc. A good deal of work has been done, and prospects are considered encouraging.

According to recent arrivals at Fairbanks there is considerable winter work being done in the Hot Springs, Koyukuk, and Ruby districts. Prospects are considered promising.

NOME

The deputy-collector of customs at Nome, R. W. J. Reed, has given out the following data regarding the navigation season of 1915:

Ocean vessels arrived, coastwise	40
Net tonnage	65,195
Ocean vessels departed, coastwise	40
Net tonnage	68,047
Arrivals from foreign ports	13
Net tonnage	5,045
Departures for foreign ports	15
Net tonnage	5,593
Freight received from United States ports:	
General merchandise, tons	13,910
Fuel oil, crude, tons	1,029
Coal, domestic, tons	3,214

Lumber, feet, b. m.	1,070,469
Live stock, head	46
Freight shipped to United States ports:	
General merchandise, tons	1,872
Placer tin, tons,	157
Antimony ore, tons	132
Gold dust and bullion shipped:	
Through Customs house, 151,567 oz., value	$2,796,952
Merchandise received from foreign ports:	
Value of free imports	$124,408
Value of dutiable imports	2,916
Foreign coal, tons	1,185
Passenger movements:	
Arrived from United States ports at Nome	1,604
Arrived from United States ports via Nome for St. Michael	183
Arrived from foreign ports	2
Departed for United States ports from Nome	1,402
Departed for United States ports via Nome from St. Michael	506
Departed for foreign ports from Nome	2

ARIZONA

In Bulletin No. 6 of the State Bureau of Mines, Charles F. Willis briefly describes the present condition of mining and industrial progress in the State. Bulletin No. 8, by P. E. Joseph, is on asbestos. The asbestos of Arizona is of excellent quality, and is unique in occurrence in that it is found as chrysotile in cross-fibre veins with serpentine in limestone. The principal deposits are in the Grand Canyon of the Colorado and on Ash creek, 40 miles from Globe. At the latter place, the new asbestos mill of Fisk and Snell, designed by T. Torrey of Canada, is producing one ton of fibre daily.

Cochise County

The most important new work under way in the Bisbee district is concreting the Copper Queen company's Sacramento shaft. Three hundred feet is finished, the rate being 10 ft. each three days. The fire in the Lowell ground is under control, and isolated by bulkheading. A good body of sulphide ore was cut recently at 700 ft. of the Spray shaft. A new hoist is being erected at the White Tail Deer lease.

Work continues at a big pace at the Calumet & Arizona and Shattuck mines.

Gila County

Two electric pumps on No. 18 level of the Old Dominion are lifting a little more than 6,000,000 gal. per day. The mine is producing 1000 tons of ore daily, mostly from No. 12, 14, and 16 levels. The mill is treating 700 tons per day. An M. S. flotation machine is treating the slime; coal tar is used, coming in tank-cars. Concentrate is thickened by a Dorr machine, and dried on an Oliver filter. Three blast-furnaces are working on company ore and concentrate, and custom ore. New economizers are being installed at the power-plant.

The Irene of Globe Mining Co. is starting to grade for a 50-ton mill at its silver-lead-zinc mine. James A. Fleming is president.

During November the Inspiration mill treated 180,000 tons of ore. The first unit of the second half of the plant is in operation. The automatic hoists at the main shafts are working well. Most of the ore comes from the Joe Bush orebody at No. 4 level. New concrete assay and engineering offices are nearly complete.

A 300-ton test-mill is being erected at the Miami mine, to be ready early in January. This will treat experimentally, also commercially, the low-grade ores.

Owing to a rush of ground from a stope above the 300-ft. level of the Gibson mine, W. ('Tip') Henderson, one of the owners, was killed. Beck, Gibson, and Henderson bought this mine in 1901 for $1000. In 10 years they produced $1,800,000, and since then $250,000, mostly by lessees.

Yavapai County

The old Blue Duck mines in the Hassayampa district will probably be re-opened by Cleveland, Ohio, people, Judge T. H. Bushness being one of them. The ore yielded exceptionally high in silver.

The mine of G. Thompson, in the Tule Creek tungsten area, is producing good ore in shallow shafts.

Like the old Tip Top mine, the Pearl silver mine is said to contain wolfram ore. Other claims have good tungsten prospects.

CALIFORNIA

The State Industrial Accident Commission has issued 'Mine Safety Rules,' of 123 pages, also 'Miscellaneous Rules for Underground Men' of 7 pages, which are effective on January 1, 1916. The latter is to be published in Spanish, Italian, and Croatian (all Slavic dialects, such as Bohemian, Polish, Serbian, and Slavonian are included in Croatian). The mine-safety rules were drafted by A. P. Anderson, G. W. Metcalf, N. S. Kelsey, and Arthur B. Foote, representing the California Metal Producers' Association; James Giambruno, J. C. Williams, and A. M. Arandall for the mine employees, and H. M. Wolfin for the Commission. Under Section 5 artificial breathing apparatus is discussed, but this is not effective until April 1. The publication contains all points coming under safety practice. Section 2, 'Reports to Inspector,' the U. S. Bureau of Mines will send forms to California mines requesting data for 1915. The request will be made that these forms be filled out and mailed to the Commission. If operators and superintendents will see that this request is complied with within a reasonable time, no request will be made by the Commission for additional annual reports to the inspector for 1915. The index of 21 pages is very complete. 'General Safety Orders,' of 15 pages, has also been issued. They are effective on January 1. The names of the committeemen responsible for the orders are given. Safety-first accomplishments (the work done by the Commission) occupy two pages.

Amador County

Following is the preliminary report of the output and expenditure of the Plymouth Consolidated for November:

Ore milled, tons	10,000
Value of gold	$46,949
Working expenses	24,184
Development charges	4,640
Surplus	$18,125
Capital expenditure	204

The Sutter Creek Mining Co. has acquired the Poundstone mine at Sutter Creek, once known as the East Eureka. It is well equipped, including an electric hoist, compressor, and 20-stamp mill.

Two men were killed in the Kennedy mine on December 20. A timber-boss, W. T. Harvey, walking down the ladderway of the shaft, slipped off and fell on top of an Italian miner who was riding on a skip, both then falling to the bottom of the shaft, 3900 ft. deep.

The South Eureka company treated 12,050 tons of ore in November, yielding $51,002, and a profit of $14,975. A dividend of 5c. per share has been declared, equal to $30,988. The company employs 250 men. It has commenced exploration on the lower levels of the Oneida mine, nearby.

At the Central Eureka mine 30 stamps are crushing ore from the 2800, 3000, 3100, and 3200-ft. levels. J. E. Davis is in charge of 100 men.

Nevada County

In order to loosen a long bank of gravel at the Brandy City Gravel Mines, in charge of G. F. Taylor, 22,000 lb. of powder is to be set off. Twenty men are employed.

The Golden Center company has declared dividend No. 2 of 4c. per share, equal to $11,500. The main shaft is down 833 ft. Ore reserves are sufficient for an increased mill capacity.

Placer County

(Special Correspondence.)—Owners of the Grey Eagle mine, four miles from Forest Hill, have ordered two Joshua Hendy batteries of three stamps each.

The third unit of three stamps at the Excelsior mill is nearly ready for crushing. The nine stamps will be able to reduce 150 mine-cars of ore daily.

Forest Hill, December 17.

The Valley View mine, near Lincoln, has been bonded to the Guggenheim interests for $25,000. This firm is operating the Dairy Farm mine near Sheridan.

Plumas County

River claims (Feather river) near Rich Bar, are to be worked next year by Henry Finch of Seattle, who proposes to use a clam-shell dredge, suction pumps, and diving apparatus.

Shasta County

It is reported that 40% dynamite has advanced $90 per ton during the past two weeks. This is serious for the Mountain Copper Co., which uses 17 tons a month at its Iron Mountain mine. The Mammoth company uses more. Forty and sixty per cent dynamite cost $330 and $420 per ton respectively.

Sierra County

Owing to a heavy snowfall the transmission-line from Pike City to Alleghany was broken, resulting in the mines, plants, and the towns of Alleghany and Forest City being without light and power.

The Eastern and Western Cross claims of Bovee Bros. have been bonded to P. O. Jackson of Iowa for $50,000.

Siskiyou County

Manganese claims near Greenview are likely to be sold to San Francisco people.

Trinity County

Gravel near Hayfork is being tested by a Keystone drill for San Francisco people.——The Heurtevant ranches below Junction City are said to be sold to a New York syndicate, which may erect a dredge.

On account of the winter, work has been suspended at the Trinity Asbestos Mining Co.'s property at Castella. A 100-ton rock-crushing plant, 25,000-ft. sawmill, and 12 miles of 6% grade road were constructed, the latter costing $45,000. H. T. Mecum of Oakland is president.

Tulare County

Two miles from Lindsay a rich magnesite deposit has been discovered.

COLORADO

Clear Creek County

According to the superintendent of the Big Five tunnel, D. A. Barry, the adit is to be extended another 1000 ft., making 10,053 ft. It will be driven by contract. The heading is within 250 ft. of the Gilpin County line. The new work will go under the south slope of Pewabic mountain. Beyond and along its course are most of the big mines of Russell gulch. A good deal is expected from the extension in the way of developments.

San Juan County

Experiments in flotation are under way at the Sunnyside mill at Silverton, in charge of James H. Hyde and others.—— The Contention mill is being repaired. Flotation will probably be used.——Work is to be resumed at the North Star mine on Sultan mountain.——The tungsten mines on Cement creek are sending ore to the local mill.——Developments at the Buffalo Boy are very satisfactory, the shoot being over 1000 ft. long. Sinking is underway.

San Miguel County

During November the Tomboy mill treated 12,000 tons of ore, yielding $42,000 of bullion, and $44,500 of concentrate, a total of $86,500. The profit was $28,400.

IDAHO

Boise County

In the Deadwood district the Hall Interstate Mining Co. has a fairly developed high-grade lead-silver mine. It requires a 12-mile wagon-road to allow shipments to be made.

Boundary County

A No. 45 Bucyrus steam-shovel is to be used by the Idaho Gold & Ruby Mining Co. in digging a ditch for hydraulicking at Lenia. Sluicing is to commence in July next. Sixty men are employed. The ditch is about half finished, excavation started in November 1914. The canal, 4¼ miles long, 12 ft. wide at the bottom, 30 ft. at the water-line, and 60 ft. at the top, will carry an average of 2000 second-feet of water, adequate for maximum operations. It will be supplied from Boulder creek, a tributary of the Kootenai river, and when completed will represent an expenditure of not less than $100,000, according to the president, John L. Schnatterly.

Shoshone County (Coeur d'Alene)

A well-defined lode of quartz, iron, and galena, 8 to 20 ft. wide, has been traced by trenches for 2000 ft. in the Virginia claim of the Red Monarch Consolidated in the Nine-Mile district. An adit has been started on the orebody. Diamond-drilling on the Red fraction has disproved the theory of faulting. A compressor-plant and boarding-house are being erected. Conrad Wolfle of Spokane is president.

In the Murray district is the old Golden Chest property of large area, where work has been resumed after eight years. About three miles of openings have been made in the past. A stamp-mill worked for many years. The Klondike ore-shoot yielded $250 per ton in lead, silver, and gold, and large quantities of tungsten ore were discarded. Samuel Green of New York intends to operate the mine mostly for tungsten ore.

The Success company in the Nine-Mile district made a profit of $70,000 in November. On December 23, 3c. per share was paid, equal to $45,000. This makes $555,000 for 1915, and $1,830,000 to date.

At a vertical depth of 325 ft., and at a point 1410 ft. from the portal of the adit, the vein in the Richmond mine at Adair has been cut. The shoot in the upper levels is 500 ft. long, from which six carloads of ore returned $4600 net.

For $250,000 the Rex Consolidated company has secured an option on control of the Black Bear Consolidated stock. Black Bear ore will be treated at the Rex mill at Nine-mile, now used by the Tamarack & Custer.

Well-known mining people, constituting the Northwestern Mines Development Co., have purchased property in the Keller-Nespelen district for $150,000. The ores contain copper, gold, silver, and zinc. W. E. Malm of Wallace is general manager.

MICHIGAN

The Copper Country

The *Boston News Bureau* has calculated the following output and profits of the Calumet & Hecla and its subsidiaries in 1915:

	Pounds.	Net.	C. & H. equity.
Calumet & Hecla	65,000,000	$5,500,000	$5,500,000
Ahmeek	20,000,000	2,200,000	1,100,000
Osceola	18,000,000	1,400,000	450,000
Allouez	10,500,000	950,000	380,000
Isle Royale	10,000,000	550,000	115,000
Superior	4,000,000	270,000	135,000
Centennial	2,500,000	150,000	70,000
Total	130,000,000	$11,020,000	$7,750,000
Per share on C. & H.			77.50

Calumet & Hecla's receipts from subsidiary dividends in 1915 will have been $862,776, which, with its own profits would make $6,300,000, or $63 per share against the $77.50 calculated.

(Special Correspondence.)—The third of the large furnaces

for the Calumet & Hecla smelting-plant at Hubbell is now being constructed; work will be continued during the winter, making this a valuable addition to the plant. The new furnace will have a capacity of 150,000 lb., and will have electric equipment for loading and dumping. It is modelled after No. 20 and No. 21, each of which has a similar capacity. In addition to these three large furnaces the plant at Hubbell has 15 smaller ones, each with a capacity of 30,000 lb. The Calumet & Hecla smelting and refining plants at Hubbell now have a pay-roll of 500 men, twice what it was a year ago.

Ahmeek's mill now is operating six stamps and crushing close to an average of 100,000 tons of copper ore each month, so that the production is now at the rate of better than 25,000,000 lb. per year.

Sales of metal from the Quincy have been made four months in advance.

Houghton, December 10.

MISSOURI

Jasper County

It was hoped that the zinc-lead region would produce a total value of $25,000,000 this year, but this will probably not be attained, as for 50 weeks the amount is $24,003,765, and the present price of ore is rather too low to make up the former figure. Joplin and the Webb City-Carterville districts have produced as much as the whole region in 1914.

MONTANA

Cascade County

(Special Correspondence.)—The continued demand and future of copper is said to be responsible for changes made in the concentrating work being done in the Boston & Montana reduction department at Great Falls.

It was understood that work in the mill here would be discontinued on January 15, 1916, concentrating to be done at Anaconda, and the concentrate shipped here for treatment. While no official announcement has been made it is understood that there will be no shut-down, and the plant will continue operating for an indefinite period. The concentrator at present employs about 100 men.

Great Falls, December 15.

Silverbow County

The president of the Butte & Zenith company, I. Freimuth, is at Butte from Duluth, and work is soon to be resumed at the mine in charge of W. Gibson. The ground has been opened to 670 ft., while the plant is equal to 1500 ft. The shaft is to be sunk to 1000 ft. The property is four miles west of Butte, near some other good claims.

The new flotation-plant at the East Butte has started work.

NEVADA

Esmeralda County

During November the Jumbo Extension shipped 2655 tons of ore worth $70,000, giving an estimated profit of $25,000. Lower-grade ore had to be mined, and was included in the shipments, reducing the grade. It was more economical to extract this ore than to leave it for a later period. The mine is in fine condition. Stopes 541 and 546 are giving assays from $50 to $200 per ton over 4 to 7 ft. Owing to a connection with the Velvet shaft at 790 ft. better ventilation has resulted. The output for 14 months totals 24,209 tons worth $1,072,912, of which $612,853 was net; dividends amounted to $493,410.

The Atlanta is producing three cars of ore per week from the 1580 and 1620-ft. levels.

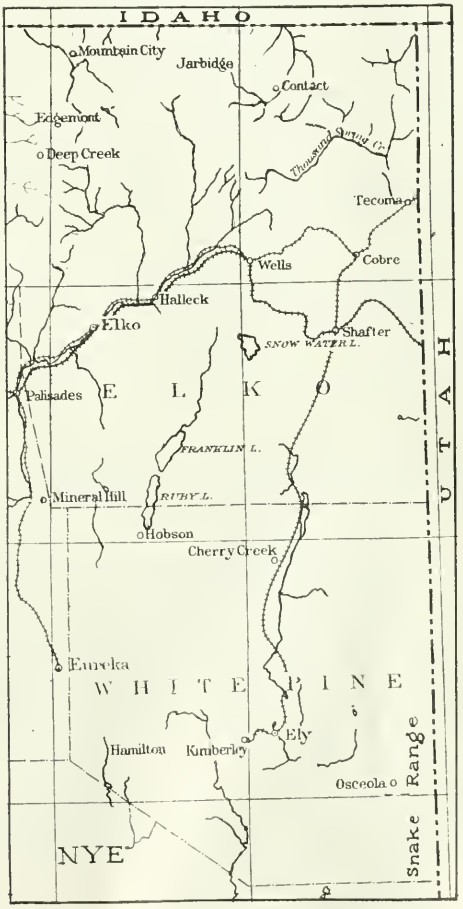
The ore-channel opened in workings above the Simmerone's 100-ft. level has been reached by the drift at that depth. Work is to be started at 250 feet.

Development at the old Tip Top mine is said to be highly encouraging. Reno people are mostly interested.

At a depth of 170 ft. in the Pioneer Consolidated, 50 miles south of Goldfield, a face of ore 11 by 12 ft. has been exposed, assaying in sections from $3.20 to $226 per ton. This is considered very important. Other parts of the mine are opening well.

White Pine County

The Snake Range district is attracting many prospectors and others. Owing to a recent discovery by E. Millick and Jasper Fox, at the southern end of the range, 25 miles or so south of Osceola, the scheelite and hübnerite belt now extends



PART OF NEVADA. THE TUNGSTEN DEPOSITS ARE IN THE SOUTHEAST OF WHITE PINE COUNTY.

for a length of 70 miles. Between Minerva and north of Red Hills there are three mills in operation, another is to be erected at Scheelite. About 300 men are employed in the region in various ways.

The Nevada Consolidated company's November *Safety First* shows that 11 accidents at Copper Flat, 25 at the Ruth mine, 2 at the mill, and 6 at the smelter, resulted in a total loss of time to the men of 356 days.

All the tungsten camps in the east part of the county are busy. Four mills are producing concentrate. New developments are frequently reported in the Snake Range area.

Molybdenite has been found by A. Munter in the north-east

corner of the county. The ore contains 7% metal. The deposit was located 10 years ago, but was not developed.

HUMBOLDT COUNTY

At Rochester the Friedman adit is in 1500 ft. At 1470 ft. a raise is going up to connect with winze 301, and the east vein will be cut 340 ft. below the bottom of the winze.

More than $100,000 of gold and silver bullion per month from the mines in the Rochester and Seven Troughs districts in this county in excess of 1914 monthly shipments, are passing through the banks of Lovelock.

In digging a hole at Antelope Springs, 25 miles from Lovelock, a badger threw out rich antimony float. This was noticed by J. H. Caustin, who has found a five-foot lode containing up to 60% antimony. Forty feet has been exposed. Ten tons was extracted in one day.

The Nevada Packard mill is said to be extracting 98% of the silver and gold-content of the ore, 112 tons being treated daily.

Some remarkable cinnabar has been opened in Dry gulch, in the Unionville district, by Alvin Chester. A wagon-load from 25 ft. depth returned $742.

LINCOLN COUNTY

The first unit, 50 tons, of the Amalgamated mill, at Pioche, is to be erected at once. Concentration by water and flotation are to be included.

The Prince Consolidated has acquired the Pioche King property.

The Bristol district is very busy. The California-Nevada and Tempest are shipping.

LYON COUNTY

In the suit of the Pacific Livestock Co. *v.* the Mason Valley Mines Co., in which the former tried to stop the operation of the smelter at Thompson, on account of alleged damage by fume, the appeal to the Supreme Court was dismissed.

NYE COUNTY

A circular from the Round Mountain Mining Co. states that from April 1 to September 30, inclusive, the revenue from 25,345 tons of ore was $145,162, or $5.73 per ton. Costs, including depreciation, were $4.39, leaving $1.34 per ton, or $33,852 profit. Hydraulicking 18,150 cu. yd. (part clean-up) gave $33,102, or $1.82 per yard. Costs were 49c. per yard, leaving $24,179 profit. The total profit was $58,031. The whole water supply and sluicing outfit cost $192,888. It has been paid for. The company has no debts. Cash on hand at the end of September was $7545.

Tonopah mines last week produced 9716 tons of ore worth $200,848.

For November the Belmont reports 12,503 tons treated for 217,777 oz. bullion, and $64,535 profit; the Tonopah M. Co., 12,200 tons of $15.44 ore, and $92,800 profit, and the Jim Butler 4407 tons for $18,949 profit.

STOREY COUNTY

Last week the Mexican mill shipped bullion worth $15,000, the result of treating ore from 2400 and 2500 ft. in the Union and Sierra Nevada. The plant is now treating 60 tons per day. ——Favorable formation is being driven on at 2700 ft. in the Ophir.——At Gold Hill, important work is under way at 1600 ft. in the Jacket-Crown Point-Belcher property. The mill is working full time.

NEW MEXICO

GRANT COUNTY

It is reported that the Burro Mountain mill will commence operations in January. Concentrate will be shipped to Douglas.

OREGON

JACKSON COUNTY

It is reported that molybdenite has been discovered in Ashland Creek canyon near Ashland. A local syndicate will develop the deposit.

SOUTH DAKOTA

LAWRENCE COUNTY

According to George V. Ayres in *The Pahasapa Quarterly* of the South Dakota School of Mines at Rapid City this county has now over 100 miles of the best highways in the State. From 1883 to 1911 the sum of $454,658 was spent on roads and bridges, with no satisfactory result; but the expenditure of $330,210 from July 1911 to July 1915 resulted in the above length of roads. These are of great benefit to the mining industry.

The *Lead Daily Call* of December 11 was a special large edition devoted to the district, including the principal mines and men.

The Homestake company has shipped a carload of wolfram from small shoots in the Hidden Fortune claims. No large deposit has been found.

UTAH

According to *The Salt Lake Tribune* Utah mines this year have produced 10,500,000 tons of ore valued at $60,000,000. This is an increase of 2,000,000 tons and $23,000,000. These valuations were carefully made on average metal prices. The metal output will be approximately 190,000 oz. gold, 13,000,000 oz. silver, 185,000,000 lb. copper, 220,000,000 lb. lead, and 23,000,000 lb. spelter. Bingham, the Cottonwoods, and Park City show large gains.

Transactions on the Salt Lake Stock Exchange during 11 months totaled 15,461,931 shares, valued at $3,388,875, compared with 3,387,020, worth $693,473, in the whole of 1914.

BOXELDER COUNTY

Net profits of the Lakeview Mining Co. in November were $31,000, from 19 cars of 32% zinc ore. The dividend was 2½c., equal to $12,500. S. S. Arentz is superintendent. The Promontory district is certainly busy, considering that it was unknown a year ago.

JUAB COUNTY

The coming year is expected to be a busy one in the Tintic district. It is probable that the Plutus and Godiva companies may consolidate for extensive development.

PIUTE COUNTY

'Recent Alunite Developments near Marysvale and Beaver, Utah,' is the title of Bulletin 620-K of the U. S. Geological Survey by G. F. Loughlin, from which the accompanying map is taken. In the PRESS of November 27 the potash question was discussed editorially. The character of the deposits and their value is described in an interesting manner. A plant at Marysvale is now producing 25 tons of potash per day from this mineral.

SALT LAKE COUNTY

A 100-ton sulphuric-acid plant is to be erected at the A. S. & R. smelter; it will take four months for construction.

SUMMIT COUNTY

Metals sold by the Silver King Consolidated from January to November, inclusive, were 567,541 oz. silver at 48.75c. per oz., and 6,827,684 lb. lead at 4.57c. per lb. The profit was $276,676.

CANADA

BRITISH COLUMBIA

Seven feet of zinc ore, with some lead, is being opened between No. 7 and 8 levels of the Standard mine at Silverton. At the east end of No. 710 stope there is 135 ft. of ore without a break.

The Hedley company, operating the Nickel Plate mine, has declared its 3% dividend, with an extra of 7 per cent.

Ontario

During November the Nipissing high and low-grade mills treated 125 and 6448 tons of ore respectively, yielding silver worth $164,846. The refinery shipped 531,096 oz., part being from custom treatment. Prospecting by hydraulicking was stopped, 111 acres being sluiced during the season. At No. 73 shaft, a raise from the first level to the surface, 80 ft., a 1½-in. vein was partly developed, assaying 2500 oz. per ton. Other veins, containing up to 3407 oz. per ton, were opened. Work on the Nipissing portion of the Cobalt Lake fault vein will be done through shaft No. 81, which is down 86 ft. Levels will be driven at 350 and 475 ft. Surface plant has been erected.

The Beaver Con. shaft is down 1234 ft. The diabase-keewatin contact occurs between 1600 and 1700 ft. The shaft will be sunk to this point. The mill is treating up to 150 tons daily. The company had at the end of November $122,674 cash, and 220,015 oz. silver in various stages. The company has commenced development of the Kirkland Lake Gold Mines property in the Kirkland Lake district.

Dividends paid by Cobalt, Porcupine, and Kirkland Lake companies are as follows, according to *The Northern Miner*:

	1915.	To date.
Beaver	$ 120,000	$ 590,000
Buffalo	.....	2,787,000
Caribou Cobalt (Drummond)	125,000	225,000
Casey Cobalt	.....	203,249
City of Cobalt	.....	139,321
Cobalt Central	.....	192,845
Cobalt Lake	.....	465,000
Cobalt Silver Queen	.....	315,000
Cobalt Townsite	.....	966,726
Coniagas	600,000	7,840,000
Crown Reserve	141,505	6,102,399
Foster	.....	45,774
Hudson Bay (Timiskaming and Hudson Bay)	.....	1,940,250
Kerr Lake (holding company)	450,000	5,970,000
LaRose (holding company)	412,122	6,591,983
McKinley-Darragh Sav.	269,723	4,606,751
Mining Corp. of Canada	259,375	518,750
Nipissing Mines Co. (holding Co.)	1,200,000	13,840,000
Right of Way Mines	.....	219,110
Right of Way Mining Co.	.....	324,643
Peterson Lake	126,095	252,191
Seneca Superior	335,218	981,212
Timiskaming	75,000	1,459,156
Trethewey	.....	1,061,998
Wettlaufer	.....	637,465
Private corporations	175,000	3,825,000
Total	$4,289,038	$62,100,823

Porcupine and Kirkland Lake:

	1915.	To date.
Hollinger Gold Mines	$1,560,000	$4,170,000
Dome Mines	400,000	400,000
Porcupine Crown Mines	240,000	420,000
Rea Mines	12,000	12,000
Tough Oakes Gold Mines	65,187	65,187
Total	$2,277,187	$5,067,187

During November the Alexo nickel mine shipped 1305 tons of ore to the smelter at Coniston. This was a record.

At Kowkash a contract has been let to sink a shaft 50 ft. at the King-Dodds claim. This will be the first serious development among the 440 claims staked in the district.

Yukon

No. 1 dredge of the Canadian Klondyke company stopped for the winter on November 28, beating all records for creek work, having worked 11 days longer than the season of 1914.

PERSONAL

Robert A. Kinzie is at Oatman.

B. L. Thane is here from Juneau.

George Macfarlane has returned from Burma to London.

G. D. Kislingbury left San Pedro on December 18 to return to Rosario, Mexico.

H. W. Turner has been examining quicksilver prospects in Monterey county.

Eugene B. Braden has returned from a month's visit in New York and Washington.

S. S. Clarke has been appointed superintendent for the St. Joseph Lead Co., at Leadwood, Missouri.

Richard Roelofs, general manager of the Cresson mine at Cripple Creek, has been visiting Oatman, Arizona.

Ralph E. H. Pomeroy, superintendent of the Steptoe Valley smelter, has been visiting Great Falls and Anaconda.

Edward T. McCarthy has returned from Russia to London, after inspecting the Spassky and Atbasar mines in Siberia.

P. O. Wells, consulting engineer for the Cerro de Pasco Mining Co. in Peru, is touring the Western copper districts.

George B. Holderer, manager of the Furlough Development Co., at Wickenburg, Arizona, will spend Christmas in New York.

Henry G. McClain has succeeded W. E. Tracy as superintendent for the Liberty Bell Gold Mining Co., at Telluride, Colorado.

L. W. Trumbull is now in the oil-fields of southern Illinois. He will be at the Raleigh, Washington, D. C., during the G. S. A. meeting.

Russell G. Wayland has been promoted from assistant superintendent to chief superintendent of the Alaska Treadwell group.

H. W. Hardinge has been awarded the John Scott medal, for the invention of his conical mill, by the Franklin Institute, Philadelphia.

T. Skewes-Saunders formerly assistant-manager of Las Dos Estrellas, at El Oro, Mexico, succeeds Andre P. Griffiths as general manager.

Chas. E. van Barneveld, Professor of Mining in the University of California, is visiting Washington during the Christmas vacation.

W. L. Cumings has returned home from a four months trip to Peru and Chile, where he made various examinations for the Bethlehem Steel Company.

L. H. Metzger, formerly with the Goldfield Consolidated, succeeds R. G. Wayland as assistant superintendent of the Alaska Treadwell group of mines.

L. G. Huntley of the firm of Johnson & Huntley, Pittsburg, recently returned from the Kansas and Oklahoma oilfields, and is at present engaged in professional work in West Virginia.

Philip R. Bradley has become general superintendent of the Alaska Juneau mine, retiring as superintendent of the Treadwell group, with which he will continue to be connected as consulting engineer.

J. C. Puttner, superintendent of the San Juanes Reduction Co., Lower California, Mexico, is returning to the property after three months in the States. The company operates south of the El Boleo, and has not been affected by the revolution.

George J. Maas, of Negaunee, Michigan, died December 2, aged 54. Besides being known for the Maas diamond-drill compass, he was a successful explorer for iron ore and a fee-holder of Michigan lands.

THE METAL MARKET

METAL PRICES.

San Francisco, December 22.

	Cents per pound.
Antimony	40
Electrolytic copper	20.75
Pig lead	5.65— 5.85
Quicksilver (per flask)	$130
Spelter	20
Tin	40
Zinc-dust, 100-kg. zinc-lined cases	30

ORE PRICES

San Francisco, December 22.

Antimony: market weaker; 50% product, per unit	$ 2
Chrome: 52% chromic oxide and 2% silica per ton	12
Magnesite: plastic, no iron and lime, calcined, per ton	55
Magnesite: refractory, up to 7% iron, calcined, per ton	30-35
Manganese, 50% metal, 8% silica, per ton, f.o.b. cars, S. F.	12
Tungsten: minimum 65% WO_3, per unit for spot	$35—45

New York, December 17.

Manganese: For Brazilian ore, such as is used in the manufacture of 80% ferro-manganese, 44c. per unit has been paid. Plenty of Brazilian ore is to be had provided ships can be found for its transportation. One steamer was offered at a rate that would have made the cost of the ore 64c. per unit. The U. S. Steel Corporation recently contracted for 85,000 tons of Brazilian manganese ore. Shipping conditions are such that Indian ore is practically unobtainable.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 23.—There is renewed activity in copper, and it is steadily rising; lead is quiet but firm; prompt zinc is scarce, the market is firm.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec. 16	55.12	Nov. 10	50.02
" 17	55.12	" 17	50.46
" 18	55.25	" 24	52.35
" 19 Sunday		Dec. 1	56.27
" 20	55.37	" 8	55.54
" 21	55.37	" 15	55.66
" 22	55.12	" 22	55.22

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	57.58	48.85	July	54.90	47.52
Feb.	57.53	48.45	Aug.	54.35	47.11
Mch.	58.01	50.61	Sept.	53.75	48.77
Apr.	58.52	50.25	Oct.	51.12	49.40
May	58.21	49.87	Nov.	49.12	51.88
June	56.43	49.03	Dec.	49.27	....

The undertone continues good, due to large sales to Europe coming on a market bare of supplies. Export of silver to India and China from London to December 1 totaled £3,559,000, against £4,721,500 in that period of last year. On December 18 a shipment to China from San Francisco was valued at $716,180, equal to about 1,300,000 oz. According to J. S. H. Umstead, in 'Financial America,' the world is facing a deficit in silver production of 50,000,000 oz., with no new field in sight.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date.		Average week ending	
Dec. 16	19.75	Nov. 10	18.08
" 17	19.87	" 17	18.58
" 18	19.87	" 24	19.58
" 19 Sunday		Dec. 1	19.77
" 20	20.12	" 8	19.60
" 21	20.25	" 15	19.54
" 22	20.50	" 22	20.06

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	14.21	13.60	July	13.26	19.09
Feb.	14.46	14.38	Aug.	12.34	17.27
Mch.	14.11	14.80	Sept.	12.02	17.69
Apr.	14.19	16.64	Oct.	11.10	17.90
May	13.97	18.71	Nov.	11.75	18.88
June	13.60	19.75	Dec.	12.75	....

Exports during the week ended December 4 totaled 20,332,169 lb., valued at $3,802,107. Of this, England absorbed 5,706,520; France, 7,871,554, and Russia, 2,581,374 lb. Imports amounted to 1,882,839 lb., worth $183,244. Chile sent 1,062,900, and Peru 247,973 pounds.

November returns include 6,000,000 lb. from Cerro de Pasco, and 4,000,000 lb. from Miami.

Phelps, Dodge & Co. paid $20 per share this year, against $14 in 1914. Granby Consolidated will pay $1.50 per share on February 1.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date.		Average week ending	
Dec. 16	17.50	Nov. 10	15.63
" 17	17.50	" 17	17.02
" 18	17.50	" 24	18.58
" 19 Sunday		Dec. 1	18.52
" 20	17.50	" 8	15.83
" 21	17.50	" 15	16.04
" 22	17.50	" 22	17.50

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	5.14	6.30	July	4.75	20.54
Feb.	5.22	9.05	Aug.	4.75	14.17
Mch.	5.12	8.40	Sept.	5.16	14.14
Apr.	4.98	9.78	Oct.	4.75	14.05
May	4.91	17.03	Nov.	5.01	17.20
June	4.84	22.20	Dec.	5.40	....

Ore prices at Joplin rose last week to $105, the lowest being $90 per ton for 60% product.

During November the Butte & Superior produced 16,451,000 lb. of spelter from 52,430 tons of ore. The estimated output in 1915 is 75,000 tons of metal, giving a profit of $9,000,000.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec. 16	5.40	Nov. 10	5.02
" 17	5.40	" 17	5.20
" 18	5.40	" 24	5.25
" 19 Sunday		Dec. 1	5.25
" 20	5.40	" 8	5.25
" 21	5.40	" 15	5.30
" 22	5.40	" 22	5.40

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	4.11	3.73	July	3.80	5.59
Feb.	4.02	3.83	Aug.	3.86	4.67
Mch.	3.94	4.04	Sept.	3.82	4.62
Apr.	3.86	4.21	Oct.	3.60	4.62
May	3.90	4.24	Nov.	3.68	5.15
June	3.90	5.75	Dec.	3.80	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending

Date.			
Nov. 24	105.00	Dec. 8	115.00
Dec. 1	105.00	" 15	130.00
		" 22	130.00

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	39.25	51.90	July	37.50	95.00
Feb.	39.00	60.00	Aug.	80.00	93.75
Mch.	39.00	78.00	Sept.	76.25	91.00
Apr.	38.90	77.50	Oct.	53.00	92.90
May	39.00	75.00	Nov.	55.00	101.50
June	38.60	90.00	Dec.	53.10	....

TIN

Prices in New York, in cents per pound.

Monthly averages.

	1914.	1915.		1914.	1915.
Jan.	37.85	34.40	July	31.60	37.38
Feb.	39.76	37.23	Aug.	50.20	34.37
Mch.	38.10	48.76	Sept.	33.10	33.12
Apr.	36.10	48.25	Oct.	30.40	33.00
May	33.29	39.28	Nov.	33.51	39.50
June	30.72	40.26	Dec.	33.60	....

Tin is dull at 39 cents.

The new A. S. & R. tin smelter at Perth Amboy is to receive over 600 tons monthly of concentrate from the Cia. Estañifera de Llallagua, also some from the Cia. Minera de Oruro and mines near La Paz.

Eastern Metal Market

New York, December 17.

With domestic consumers satisfied for the present, the copper trade is principally concerned with the export situation. With its munition plants now running full blast it is probable that Great Britain will be a heavier buyer of ingot copper. Already this month, 21,809 tons has been exported. Zinc quotations took an upward turn when 15c. was touched, and the galvanizers commenced to buy. To the surprise of everyone the A. S. & R. Co. advanced its lead quotations on December 14, $3 per ton. The market had been dull and weak, and the trade can only ascribe the rise to export activity. It is reported that arrivals of tin will be restricted until Great Britain has accumulated a stock of about 4000 tons. Spot antimony continues scarce, and prices are firm. Aluminum is a trifle easier. In all the metals many buyers heretofore unknown to the trade are coming to the front. Practically all of them have war orders of one kind or another.

The exchange rate for the pound sterling was firm on December 16 at $4.72.

The pressure on the steel trade is reflected in the November report of the U. S. Steel Corporation, showing that its unfilled orders, as of November 30, had increased 1,024,037 tons as compared with October 31. The total on the books was 7,189,489. The increase was next to the largest on record. The mills continue to decline business, and prices are irregular. Iron ore for 1916 delivery has been active. Heavy sales have been made of both New York state and Lake Superior ores. The producers of the latter are much concerned over the shortage of mining labor, and the question is taking rank with the shortage of boats and the high freight-rates. Ore-shippers are buying Lake boats to insure the movement of their product. Pig-iron continues to climb.

ZINC

Some large inquiries have been before the trade, but prices have been more affected by London, and certain manipulative influences here than by demand. Sellers adopted the policy of declining to quote or give refusals, thereby working the consumers up to a state of excitement. The market moved rapidly from around 15c. per pound on December 9 to 17.50c. on the 15th. Then the market became easier. At the lower level mentioned some of the galvanizers took hold and bought freely, but their activity tapered off as prices advanced, and again their buying is at a standstill. It is estimated that not more than 50% of the galvanizing industry is active. Galvanized sheets, No. 28 gauge, are quoted at 4.75 to 5c. They have been offered a little more freely of late by makers who bought spelter on the declines.

Sheet-zinc, carload lots, f.o.b. mill, was unchanged on December 16, at 22c., 8% discount for cash. The London quotations for zinc have been erratic. On December 13 the quotation was £82 for prompt; £86 on the 14th; £93 on the 15th, and £90 on the 16th. Exports from December 1 to 18 totaled 4218 tons.

COPPER

With the requirements of domestic consumers practically filled for the time being, the market has reached a stage where it is extremely responsive to conditions at London; it sways with every rumor that comes along. The minimum quotation for electrolytic has been close to 17.50c., New York, since the last report, although the producers have adhered to 19.75 to 20c., 30 days, delivered. On December 15 second-hands withdrew from the market following reports that export-sales had been made at 20c., but 19.50c. was offered again on the following day. The London price touched £98 in the week, but on December 16 it declined to £97 10s. The importance of the London market, now that domestic buying has subsided, is emphasized by the fact that the exports in the first half of this month amounted to 19,996 tons. On December 17, the total was 21,809 tons. In this connection the interesting fact is pointed out that England now has her munition factories well organized, and from now on may be expected to buy more heavily of ingot copper. Some authorities assert that there will be a falling-off in exports of manufactured products, but it is not to be forgotten that contracts in hand here must be executed, also that deliveries on some of these contracts have not begun in earnest. Orders for many hundreds of tons of sheet-brass cannot find placement, and those who would go into the business of making this product are finding it difficult to obtain the necessary machinery. The following comparative statement of copper exports from the United States in 11 months of this year was compiled by C. Mayer, secretary of the New York Metal Exchange, in long tons:

	1915.	1914.
United Kingdom	69,280	80,175
France	83,699	56,150
Germany	.....	88,452
Holland	1,280	58,940
Belgium	.....	2,876
Austria	.....	13,809
Italy	39,551	23,607
Denmark	2,126	3,875
Norway and Sweden	17,091	6,909
Russia	17,921	125
China and Japan	119	1,890
Sundries	2,851	1,255
Total	233,918	338,063

LEAD

Large export sales, quietly negotiated, are held accountable for an advance of $3 per ton, or from 5.25 to 5.40c. per pound, New York, at a time when the domestic market was dull. Consumers were well supplied and second-hands were shading prices a few points when, to the surprise of all, the A. S. & R. Co., on December 14, announced the advance. Independents followed, but in the course of a few days they were again ready to sell at 2½ points under the new price. London has been strong. Exports from December 1 to 18 total 4985 tons.

TIN

The feature in tin is a report that exports from England will be curtailed until Great Britain has in store a stock of the metal sufficient to meet future contingencies, about 4000 tons. It is understood that at least a part embargo will be placed on the metal. Except on two or three days when fair quantities changed hands the market has been dull. Practically all of the business was in futures. The spot price on December 10 was 39c., on the 16th it was 39c., and the 17th, 40c. Arrivals up to the 17th totaled 3035 tons, and there was afloat on that day 5533 tons.

ANTIMONY

The quotation for spot antimony, Chinese and Japanese grades, was firm at 39c., duty paid, on December 16, but futures were easy because of anticipated arrivals.

ALUMINUM

Virgin metal, 99% pure is a little easier at 57 to 59c., with 98 to 99% at 56 to 58c. Substitutes are still being sought and this may have something to do with the easier quotations. The leading interest still declines to quote.

RECENT PUBLICATIONS

The Rennerfelt Electric Furnace. P. 24. Illustrated. Aktiebolaget Elektriska Ugnar, Stockholm, Sweden, 1914.

Origin of the Iron Ores at Kiruna. By Reginald A. Daly. P. 31. Illustrated. Nordiska Bokhandeln, Stockholm, Sweden.

Magnetometers. P. 51. Ill., index. Fr. J. Berg, Stockholm, Sweden. Notes on the use of this instrument for surveying magnetic orebodies.

The Glacial-Control Theory of Coral Reefs. By Reginald A. Daly. P. 94. Illustrated. American Academy of Arts and Science. November, 1915.

Genesis of the Centrifugal Pump. By Albert E. Guy. P. 52. Illustrated. Colorado Scientific Society, Denver, November, 1915.
This is a valuable and interesting paper.

U. S. Geological Survey, Washington, D. C., 1915.

Production of Metals and Ores in 1913 and 1914. By J. P. Dunlop. P. 11.

Production of Coal in 1914. By C. E. Lesher. P. 60. Table.

Water Supply Papers:

South Atlantic and Eastern Gulf of Mexico Basins. Part II. No. 352. P. 84. Ill., index.

Hudson Bay Basins and Upper Mississippi River. No. 355. P. 181. Ill., index.

Surface Water Supply of Oregon, 1878 to 1910. By F. F. Henshaw and H. J. Dean. No. 370. P. 829. Map, index.

Profile Surveys in Chelan and Methow River Basins, Washington. No. 376. P. 8. Five maps.

Profile Surveys in Spokane River Basin, Washington, and John Day River Basin, Oregon. No. 377. P. 7. Nine maps.

Profile Surveys in 1914 on Middle Fork of Willamette River and White River, Oregon. No. 378. P. 8. Six maps.

Profile Surveys in 1914 in Umpqua River Basin, Oregon. No. 379. P. 7. Thirteen maps.

Western Gulf of Mexico Basins. No. 388. P. 124. Illustrated.

Contributions to economic geology, 1915, part I:

Potash in Certain Copper and Gold Ores. Compiled by B. S. Butler. With a note on muscovite by George Steiger. No. 620-J. P. 10.

A Reconnaissance in the Kofa Mountains, Arizona. By Edward L. Jones, Jr. No. 620-H. P. 14. Map.

Iron-Bearing Deposits in Bossier, Caddo, and Webster Parishes, Louisiana. By Ernest F. Burchard. No. 620-G. P. 22. Illustrated.

Recent Alunite Developments near Marysvale and Beaver, Utah. By G. E. Loughlin. No. 620-K. P. 34. Illustrated.

Professional papers, shorter contributions to general geology, 1915:

Evaporation of Potash Brines. By W. B. Hicks. No. 95-E. P. 8. Illustrated.

Erosion Intervals in the Eocene of the Mississippi Embayment. By Edward Wilber Berry. No. 95-F. P. 10. Illustrated.

Preliminary Report on the Diffusion of Solids. By C. E. Van Orstrand and F. P. Dewey. No. 95-G. P. 14.

Notes on the Geology of Gravina Island, Alaska. By Philip S. Smith. No. 95-H. P. 9. Illustrated.

The Age of the Ocala Limestone. By Charles Wythe Cooke. No. 95-I. P. 11.

Abstracts from the above will appear in the Press from time to time.

A New Two-Way Side-Dump Mine-Car

The accompanying illustration shows a new type of car worked entirely by hand, claimed by The Thomas B. Jeffrey

OPERATION OF THE NEW CAR.

Co., of Kenosha, Wisconsin, to do its work quicker than most power-dump bodies. The body is fitted to a Jeffrey quad truck, which is giving general satisfaction. No further description of the machine is necessary, the photograph showing how useful it should be around mines.

Drills and Lanterns

Among new electric apparatus, the Western Electric Co., in notes entitled 'Western Electric Developments in 1915,' describes the following:

A portable electric-drill and a portable electric-hammer have been placed on the market. The former is well-balanced, compact, and light. It will give the most efficient service in drilling and tapping work under the most exacting conditions. The motor will reverse readily at high or low speed. The switch, conveniently placed near the handle, makes it easy to reverse the motor when the drill sticks.

The electric-hammer is a sturdy, compact device that will produce uniformly strong blows at the rate of 1300 to 4000 per minute. It cannot be over-loaded, nor burn out. The hammer will do the work of a pneumatic drill at a 15% saving of power alone; over hand work, the saving is from 80% to 90%.

An electric lantern operated by dry battery has been placed on the market to meet the demand for a safe light that can be left burning anywhere without danger of fire. This lantern is made in two sizes, one giving a powerful light and making use of two dry batteries, and another, with a slightly less brilliant light, arranged for one battery only. A noteworthy feature is that turning the reflector lights the lantern, and moving it in the opposite direction extinguishes the light. Turning the reflector operates the switch which is wholly concealed, so that there are no moving parts on the outside of the lantern casing. A swinging bail is provided for convenience in carrying and for locking on the top. A rigid-slotted handle is also provided for hanging the lantern on a rail. The metal case is finished in automobile lamp black enamel. The light from this type of lantern will show an object 200 ft. away.

WANTED—Competent placer miner, familiar with hydraulicking pipe and mine work. Must be sober and have good references. Knowledge of Spanish desirable but not essential. Mine situated in Philippines. Climate healthy. Good pay and steady employment to right man. Address quickly. Box 181. Mining and Scientific Press.